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(*a*) Heap containing 57 cavans of "voladores," caught with nets in five hours at Mandaue, Cebu.



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(*b*) Pit method—driving the loctones through the "V" into the pit, Province of Cebu.

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CONTENTS.

Page.

Editorial .....
The Locust Pest, by C. R. Jones, Entomologist, and D. B. Mackie, Assistant Entomologist 5
The Manufacture of Paper from Abacá (Manila Hemp), by M. M. Saleeby, Chief, Fiber Division 23
Self-sterility of the Scuppernong and Other Muscadine Grapes, by P. J. Wester, Horticulturist 28
The Bicol Farm, by E. H. Koert, Agricultural Inspector 31
Agricultural Conditions in Bohol, by E. F. Southwick, Agricultural Inspector 34
Current Notes—January: Avocado or Ahuacate; Canned Pineapples; Atmospheric Nitrogen as a Fertilizer; The Colonization of Siberia; Cost and Profit of Growing Sugar Cane in Cuba; Cassava Food Products; Rats in Cochin China; Chick Peas; Dried Mangos; Coconuts in British Guiana; Beef Industry in South America; Dried Fruits in California; Is the Arab Horse Passing; Some Unusual Animal Products; Another Shark-industry Impetus; Roach-Proof Book Varnish 40
Principal Philippine Imports and Exports—October, 1912 50
Temperature and Rainfall for Agricultural Districts in the Philippines—October, 1912.. 51

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ILLUSTRATIONS.

PLATE I. (*a*) Heap containing 57 cavans of "voladores," caught with nets in five hours at Mandaue, Cebu; (*b*) Pit method—driving the "loctones" through the "V" into the pit, Province of Cebu ..... *Frontispiece.*

Facing page—

II. (*a*) Egg destruction—tamping the ground with mauls; (*b*) Maize field—showing effect of locust attack 16

III. Locust-breeding cages at insectary, Singalong Experiment Station, Manila 16

IV. Coconut leaves breaking under the weight of "voladores," or adult locusts, Province of Cebu 16

TEXT FIGURES.

Page.

FIG. 1. Egg of locust greatly enlarged 6

2. Eggs of migratory locust with protective covering removed 7

3. Locust depositing eggs 8

4. Last moult—changing from hopper to adult 10

5. Map showing territory infested by migratory locust up to November 1, 1912 21

6. Map of Bohol 34

EDITORIAL.

Dr. GEORGE S. BAKER.

It is with the deepest regret that announcement is made of the death in San Francisco of Dr. George S. Baker, inspector in charge of the San Francisco station of the Bureau of Animal Industry, U. S. Department of Agriculture.

Doctor Baker was a pioneer in the meat-inspection service, having seen it grow from the small beginning, as a political institution, to the wholly scientific organization which it now is. On account of Doctor Baker's ripe experience and cool judgment his services for the year past were loaned to the Bureau of Agriculture by the United States' Bureau of Animal Industry to assist in solving some of the important problems connected with cattle importation and meat inspection. During his stay in Manila he contributed largely to the solution of the cattle-importation problem and wholly reorganized the meat-inspection methods of this Bureau, thereby leaving behind him in the Philippines, as he did in the United States, monuments of constructive work.

THE PRESENT STATUS OF THE LOCUST QUESTION.

By O. W. BARRETT, *Chief, Division of Horticulture.*

Were we not more or less familiar with the matter from experience in expecting serious results in that line to happen, the question of locust ravages in the Philippines would equal, if not exceed, in our minds, that other curse of the Archipelago, the typhoons. In almost every province, and in nearly every island of any importance in the Visayas, there are now, have recently been, or may be at any moment, locust outbreaks. In perhaps one-half of the cases a swarm may be readily exterminated provided the machinery of the Government offices concerned can be directed without hindrance or delay upon the center of infestation at the right time. The most serious aspect of the whole question, however, is, at present, the impregnability, so to speak, of the locust-breeding areas which continue to propagate and send forth to the destruction of valuable crops vast numbers of these voracious insects.

There are, however, several encouraging features in the locust question to-day: The people in the infested districts are now better informed than ever before as to the habits of the insects and the most efficient methods of destroying them; excellent rules and regulations are now legally effective in nearly all of the provinces and these measures actively supported by the provincial officials of all grades form the basis for a fighting organization which only requires the direct application of a sufficient amount of labor to establish complete control of all swarms in all cultivated lands; the recent increase of appropriation for locust-destruction work by the present Philippine Legislature indicates a highly commendable spirit and a good understanding of the situation on the part of the members thereof.

While the evil of obscure breeding areas remaining in the interior of several districts may continue for some little time to come to be a menace to Philippine agriculture, it is clearly possible to prevent hereafter any further losses of such magnitude as we have recently experienced, and the outlook for the complete eradication of the pest in the Philippines within a few years is decidedly favorable.

THE LOCUST PEST.

By C. R. JONES, *Entomologist,*
AND
D. B. MACKIE, *Assistant Entomologist.*

The migratory locust is, and for many years has been, the most destructive insect pest of the Philippines. Included in the term locust are at least three, if not five, distinct varieties and species belonging to the genus *Acridium;* some seem confined to the Visayas while others occur only in Luzon; the habits of all, however, are practically identical. This pest is by no means peculiar to this Archipelago, since Argentina, India, and practically the entire African continent suffer the loss of many million pesos annually from the various members of the locust tribe.

Unlike most other insects which attack economic plants, the migratory locusts are able to exist indefinitely in uncultivated lands, such as cogon-filled caiñgins, and from these clearings, which may be on mountain slopes or on well-drained ground in the interior of any island or the hinterland of any province, the swarm may finally descend without warning upon the cultivated fields. Even in these breeding areas the insects may not appear to be in great numbers at any given time, but sooner or later, prompted by the migratory instinct, the more or less numerous small colonies or swarms assemble into swarms containing hundreds of millions of individuals and, after a preliminary period of short local flights, proceed to new breeding grounds which may be hundreds of kilometers distant.

To one not familiar with their habits, the immensity of these swarms is almost incomprehensible; in many instances the entire sky is darkened for several hours during the passage of the swarm, while there were numerous instances during the past season in the Visayas in which bamboos and even coconut leaves were broken down through the sheer weight of the insects which had alighted thereon. Not only do districts adjacent to the breeding grounds of the original swarms suffer from attacks but even areas separated by strips of ocean and even mountain ranges are afflicted. This is accounted for by the fact that all the members of a given swarm do not deposit their eggs simultaneously. The older females becoming heavy with the weight of their eggs begin to lag behind and to oviposit in nearby

districts while the younger individuals continue the migration for several days, if not weeks, before finally selecting a site for their quota of egg laying. This feature is really the most serious one of the whole subject and the destruction of the several swarms, perhaps a series of swarms extending over perhaps the entire line of migration, constitutes one of the most difficult problems with which the Philippine agriculturist has to contend to-day.

In the Visayan provinces alone the loss to agricultural crops during the past six months amounts to upwards of ten million pesos. Most of this damage has resulted indirectly from one or two swarms originating in Bohol and extending over Cebu and Negros. It is believed that the swarms which recently have invaded Panay originated in the adjacent island of Guimaras. In Mindanao there are vast areas of practically uncultivated lands which form ideal breeding grounds for this pest; and in these areas it will be for some time to come practically impossible to eradicate the locusts.

To repeat then, every province containing uncultivated areas overgrown with cogon grass has its own sources of locust infestation. Small swarms may breed for several seasons in these abandoned areas, only migrating therefrom upon attaining sufficient vigor and numbers to necessitate a change of feeding area. At present, locust swarms are known to exist in some state of development in at least twenty-four provinces, while their existence is suspected in four others.

In order that the readers of the REVIEW may understand fully the principal features in the development of the migratory locust, the following notes, based upon experiments carried out by the division of horticulture during the past few months, are offered.

LIFE HISTORY.

The egg.—The eggs of the locust (fig. 1) are deposited in earth in clusters of from sixty to eighty. The individual eggs in the clusters are laid in rows side by side obliquely across the egg mass (fig. 2); the entire cluster is inclosed in a more or less waterproof viscid secretion which not only binds the eggs together in the mass, but at the same time acts as a protection against excessive moisture and parasites.

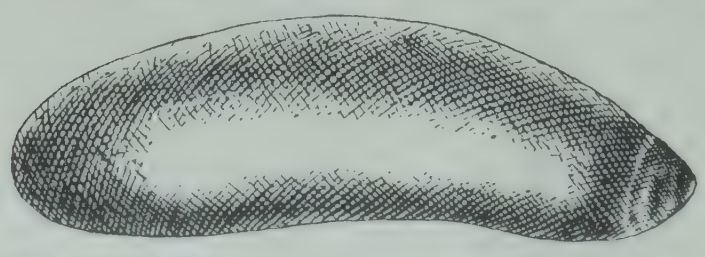


Fig. 1. Egg of locust greatly enlarged. (After Riley.)

The depth at which the egg clusters are placed depends somewhat upon the character of the soil; in compact alluvial soil the bottom of the hole is usually about 4 centimeters below the level of the surface, while in loose sandy soils the holes may be 7 or even 8 centimeters deep. The female locust is provided with two sets of hard-pointed valves at the tip of the abdomen; this entire structure is known as the ovipositor. By opening and closing these hard sections of the ovipositor and by gently moving the abdomen itself from side to side and upward and downward, a cavity large enough to contain the egg mass is made during the space of one or two hours; it should be noted that no particles of earth are removed from the cavity, the soil grains being simply forced aside by the piston-like action of the abdomen and the lever action of the ovipositor valves.

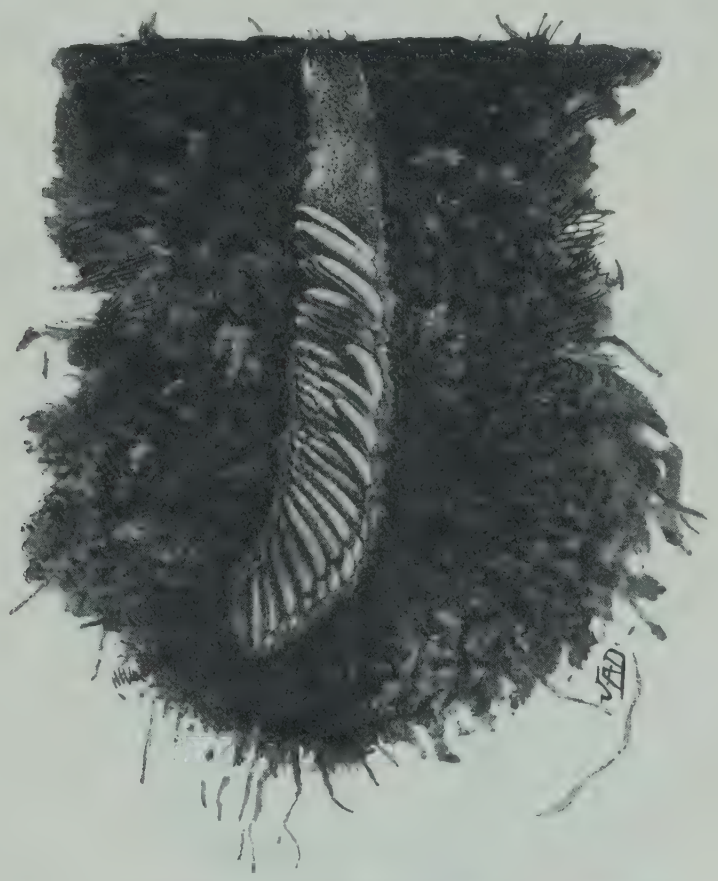


Fig. 2. Eggs of the migratory locust with protective covering removed. (Original.)

The abdomen, itself, is extended somewhat during egg laying so that the bottom of the cavity may be at a greater distance below the surface than the normal length of the abdomen. Above the egg cluster the remainder of the cavity up to the surface of the soil is partially filled with the same frothy substance which envelops each egg; this secretion prevents the loose earth from settling back into the hole on top of the eggs—which might

obstruct the exit of the young nymphs at the moment of hatching. From recent experiments by the writers it is found that excessive moisture is highly injurious to the embryonic development in the eggs; except for this waterproofing which the female locust places over her egg cluster, it is probable that comparatively few locust eggs would hatch during the rainy season.

The writers have found the average period of incubation of the Philippine migratory locusts to be from eighteen to twenty days, the minimum being seventeen, and the maximum twenty-three and a half days; in case of extreme drought it is possible that a month might pass between oviposition and the emergence of the swarm.

Three days after being deposited the individual eggs begin to swell, probably from the absorption of moisture, and at the time of hatching are nearly one-fifth larger than when laid.

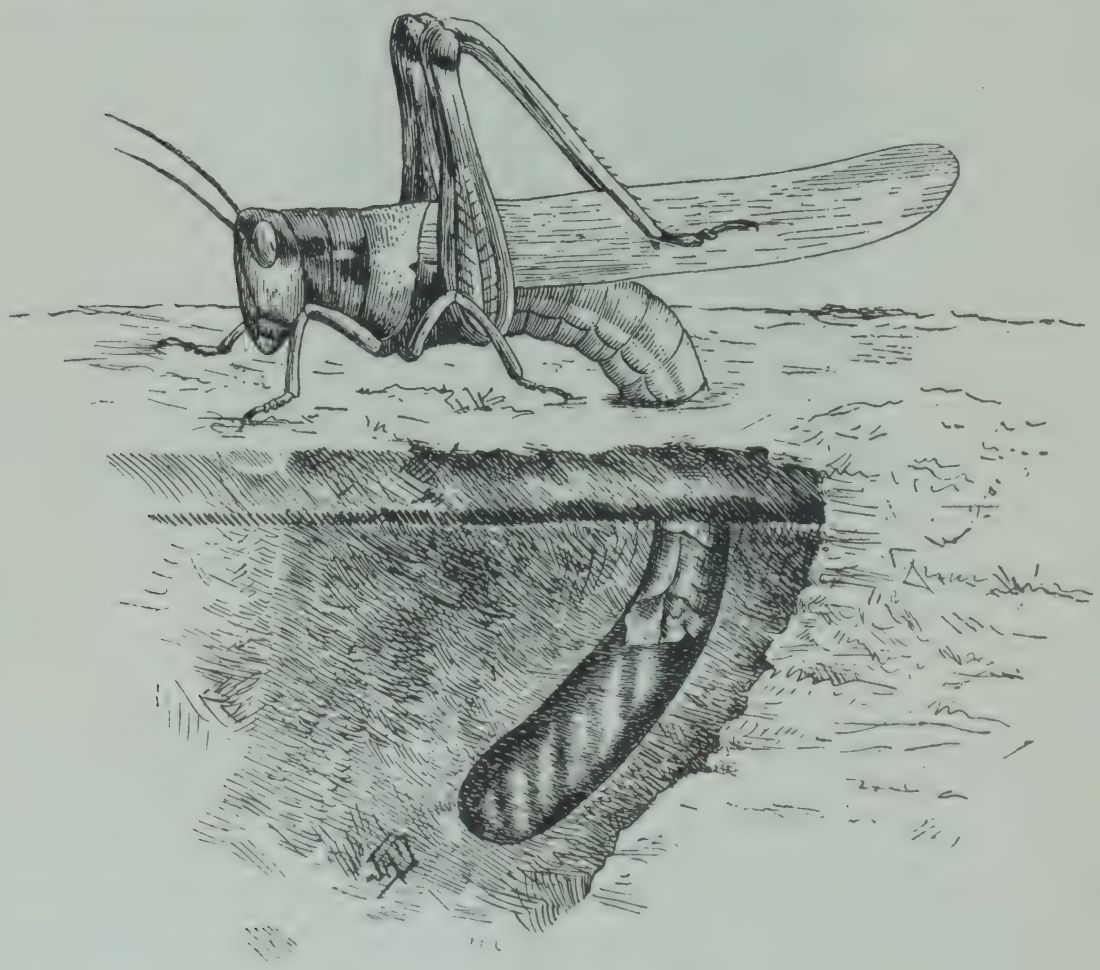


Fig. 3. Locust depositing eggs. (After Riley.)

The nymph.—Upon hatching, the young insect rapidly forces its way up through the protective covering of the egg mass to the surface of the soil. Upon emerging from the ground they

are a pale gray or fawn color and are covered with a thin film which soon dries and falls off in flakes. The young nymphs, or "loctones," closely resemble the adult, except that they are wingless and possessed of a disproportionately large head. In the course of an hour they will have changed to a slaty or brownish shade and will have slightly increased in size by reason of the minute breathing tubes in the body having become fully distended with air.

Within a few hours after emerging from the egg mass the young loctones develop ravenous appetites and begin eating. They do not, however, feed to any great extent at night, usually "going to roost" at nightfall; a grass stem or leaf is selected and, clinging tightly to this support, the young insect passes the night, striving, if possible, to avoid exposure to rain and dew.

Almost every kind of green herbage is liable to attack; sweet potatoes, tobacco, and beans are frequently passed over by the young loctones, but not even burí and coconut leaves are exempt from the attacks of the "voladores," or flying adults. Hard substances, like sugar cane, the stems of shrubs, maize stalks, etc., usually escape destruction.

The traveling instinct is very early in evidence, the young insects beginning to move in a definite direction after the first day or two of their existence; while at first only a few meters per day may be covered, by the time they are ready to molt the last time 3 or 4 kilometers may be traversed from sunrise to sunset.

The sudden appearance of vast numbers of these young loctones in a chain of localities over which the flying swarm had passed three weeks or so previously gave rise to an old belief which is not quite out of existence yet, i. e., that the young locusts are of *spontaneous origin,* some people even believing that they are sent by a special act of Providence to punish the community for some real or fancied sin.

The average time required for the nymph to reach full maturity, that is, to gain its wings, is about fifty-four days. During this period there are five molts. When ready to molt the hopper ceases feeding, crawls on some grass stem or similar object and fastening itself thereto with the claws of the hind feet, hangs head downward, motionless, for several hours. The thorax, or middle part of the body, gradually swells until the skin splits down the back; then by a series of muscular contractions, the rent in the old skin is enlarged until the body of the insect can gradually work its way out. The old skin remains attached to the grass stem, or other object, in its original position, the hopper

usually clinging to it for a short time until its tender new skin begins to dry and its legs to stiffen sufficiently for it to be able to move about. Within half an hour or so the hopper moves from the old skin to a new position, no longer remaining head downward, and there it keeps a quiet pose until the entire outer integument is quite firm again, when with a renewed appetite it again falls to feeding upon the nearest green herbage.

The adult.—At the fifth molt the wings, which have been merely indicated by minute processes at the back of the thorax, are brought into full evidence. At this molt the locton rests for a considerable time after emergence from the old skin, with the wing-"buds" hanging downward in order that the blood may gravitate into them, thus facilitating the rapid and complete extension of those organs. Only some forty-five minutes are required for drying the wings after emergence. Fig. 4 illustrates the position of the insect at the last molt just before leaving the old skin—the heavy tips of the wing "buds" bending forward contain as yet no veins or framework to hold them straight in the normal position which they will assume as soon as the insect, now called a "volador," reverses its position.



Fig 4. Last molt—changing from hopper to adult. (Original.)

After all the loctones in a swarm have acquired their wings, they usually remain for a few days longer in the immediate vicinity of their previous operations, sometimes even refusng to leave the old f e e d i n g grounds at all, provided, of course, that they find a full supply of herbage and everything else there to their satisfaction. Usually after a few short local flights, however, the migratory instinct asserts itself and the entire swarm mounts into the air and proceeds, usually with the wind, at the rate of about 30 kilometers per day, to a new breeding ground. Little is known of the exact conditions which influence the direction and extent of the flight of these swarms. Sometimes a swarm is seen to retrace its flight several times before becoming satisfied with a

particular site for egg laying. Soon after attaining their wings the adults are very active and readily take flight upon the slightest alarm; this characteristic, however, does not hold true for the later portion of the adult period of existence. A distinct odor is given off by the mature insects, especially just before and during the mating period which may last for several days. The presence of a swarm, even when it has alighted at night, may readily be detected at a distance of 5, or even 8, kilometers with a favorable wind. In a lesser degree the loctones themselves exhale a similar effluvium.

Soon after mating the females become so heavy with eggs that they can not fly with much ease and in this sluggish state they readily fall a prey to any birds or animals which happen to be near. The male may or may not die soon after copulation; the female does not live more than one or two days after ovipositing; old swarms contain a surplus of males.

The fact that the female locust deposits the entire number of her eggs in one cluster is of great importance in the work of the destruction of these insects. However, it is a very unfortunate fact for the Philippine planters that all the females of a given swarm do not deposit at the same time, nor in the same locality. It appears that due to unfavorable weather or local conditions a gravid female may carry her eggs for several days beyond the period when they are ready for oviposition.

As an evidence of the extreme degree of the gregarious sense of the migratory locust, we would mention the fact that the females of a swarm instinctively crowd together so closely while ovipositing that under ordinary conditions some 4,000 to 5,000 egg clusters are placed in one square meter of soil surface; this does not mean, however, that an equal number of female locusts were to be found in such space at any given moment of time. From these figures it is seen that from each square meter of soil surface in the area where females have oviposited, from 20,000 to 30,000 young hoppers may be expected to emerge provided neither natural enemies, bad weather, nor human methods are employed against them; when we multiply these figures by 10,000 we begin to realize the number of hoppers that may emerge from one hectare of ground.

CONTROL OF THE PEST.

The control of the migratory locust may be studied under two heads: First, artificial—which includes all methods of human control, such as spraying, driving into pits, netting, crushing, burning, inoculation, poisoning, etc.; and second, natural—which

includes influences by wind, rain, etc., and also enemies such as predaceous insects, birds, and animals, and true parasites.

The complete destruction of a winged swarm is practically impossible though, under favorable circumstances, a very large proportion may be caught in nets or, more rarely still, killed by means of contact sprays, such as kerosene. Therefore, the attention of those engaged in locust-destruction work must be directed against the eggs and loctones, or immature insects. In certain conditions it is, of course, impracticable to exterminate an extensive swarm of even young hoppers, and, in most cases, it is impossible to crush, bury, or dig out all the egg clusters even in cultivated areas. There are notable cases, however, of the total destruction of a swarm of locusts by systematic cooperative work—for instance, that performed by the Governor of Iloilo in his famous locust campaign of that province in 1910.

The destruction of eggs in cultivated ground is a matter of great importance, and, whenever practicable, should be carried out as thoroughly as possible. In fields where locusts have oviposited, the plowing of the ground is sometimes very effective, though by no means does it ensure the destruction of all the egg clusters. Where a plow with a mold-board is used, one thorough plowing is usually sufficient to bury nearly all the egg masses to such a depth that when the loctones hatch they are unable to make their escape from the earth and are, therefore, smothered therein; but when the ordinary Filipino plow is used it is necessary to either roll the land directly after plowing or to pack it by means of hand mauls. (Plate II, *a*.)

In land where a plow can not be used, excellent results have been obtained in many cases by digging out the eggs by hand, these eggs being destroyed by either crushing or pouring boiling water over them; at Carcar, Cebu, eleven persons engaged in digging out egg clusters averaged about 125 liters (about six kerosene cans full) of egg clusters per day.

APPROVED METHODS OF LOCTON DESTRUCTION.

Pit, or driving, method.—By far the most important method of combating the young insects is the common pit, or driving, method. While there are conditions under which this method can not be used with very good results in cultivated ground, it almost always is the best method to follow. Its application is not only simple but the Philippine planters in every province have been more or less familiar with its operation for many years. Its principal fault, however, is that the roofing-iron

sheets, or some similar material, which is required for the construction of the fences leading to the pit, are not always readily available; it is manifestly impracticable to carry large quantities of galvanized iron over bad roads into interior districts, especially where there is a scarcity of labor, such as in the interior districts of the Islands of Negros and Samar. In cases where it is inadvisable to attempt the use of roofing sheets, earthen dikes faced with sections of banana sheaths constitute a very effective method; the leaf-blades of the banana should not be used unless the swarm is a small one, because of the fact that the insects quickly devour the green portion of the leaf.

Plate I, *b*, indicates the appearance of a typical locust pit when full-width sheets are used. In most cases, the ordinary roofing sheet may be cut in two lengthwise, since this doubles the number of serviceable sheets and greatly facilitates handling and transportation; with very young loctones sheets cut in thirds may be used.

Considerable care should, of course, be taken in the construction of one of these pit fences in order that it may have no places where the loctones may escape through joints between sheets and that no brush or grass be left in such a position that the insects can climb over the fence. At the point of the "V" or "U" shaped structure, a pit about 1 meter wide, 1 meter deep, and 1 meter long should be constructed to receive the insects. The upper edge of this pit should be faced with iron sheets, banana-leaf sheaths, or at least banana leaves, to prevent the hoppers from crawling out of the pit.

Generally speaking, the pit fences should be erected a short distance, say 20 meters, in front of the advancing swarm; after both the fence and pit have been inspected by someone experienced in this work, as many men and boys as the size of the swarm may require take their places behind the swarm and with sticks and branches begin urging the loctones toward the pit. Inexperienced drivers in their zeal sometimes confuse the loctones by trying to force them to travel too rapidly and thus the swarm may resolve itself into a wildly struggling mass, whose movements can not be directed for some time thereafter. Under ordinary circumstances, after the construction of the fence and its pit, the entire swarm, if of moderate size, i. e., covering only some 100 square meters or more, should be inside the pit within one hour from the beginning of the drive.

The method of destroying the insects in the pit is of secondary importance, the most common and one of the best being trampling

with the feet; covering with sods or earth, or tamping with heavy sticks or mauls, are also simple and effective.

The principal difficulty with the pit method is found in the fact, that, in many cases, a swarm is not concentrated, i. e., it may not have a definite boundary; there may be in a certain field or cogonal some five to ten or more partially unified swarms, but by careful management it is usually possible to use the same fence for more than one such section of the general mass of loctones in such an area.

It is estimated that the pit method accomplished the destruction between June and October of upwards of 8,000 cavans [1] of hoppers in Bohol, while within a very short space of time some 20,000 cavans were reported to have been destroyed in Iloilo, and the total amount for the Province of Cebu may be estimated anywhere between 10,000 and 25,000 cavans.

Nets.—On level ground a large cone-shaped net, or bag, may be used to destroy the young hoppers with considerable success. The side of the net which comes in contact with the earth should be held straight by means of a straight stick; the upper part of the net should, of course, have a "bejuco" or bow-shaped piece of wood attached to the rim to hold it wide open. In certain cases extra large nets for use with horses (carabaos being too slow) may be used. Both in India and Argentina large nets drawn between trotting bullocks or horses are used with good success.

The insects caught in the bottom, or rear portion, of the net may be killed either by crushing or by dipping into hot water. The net should be constructed of coarse cloth—either canvas or gunny-sack material.

Nets having a circular frame for keeping the mouth open and mounted on short stiff handles may be used to good advantage in capturing voladores; even when "roosting" the winged insects may be captured in large numbers by beating these nets against the herbage and shrubbery where the insects have settled. In August one of the writers put this method to the test in a barrio of Cebu which was invaded by a large swarm of the flying insects, and in one hour three men using these nets captured 12 cavans of insects; also at Mandaue, Cebu, sixteen nets caught 57 cavans of voladores in five hours. (Plate I, *a*.)

Unfortunately, perhaps, in Cebu the people seldom use the locusts for food; in several provinces of Luzon, however, in the Island of Negros, and to some extent in Leyte and Bohol, the

[1] One cavan=75 liters.

Filipinos employ these nets not only to capture the locusts but to procure at the same time a quite wholesome and proper food. (The locust is a particularly cleanly insect in its habits, and beliefs as to its sometimes carrying cholera germs are probably without foundation; provided typhoid, cholera, or other similar germs could exist in a virulent state upon grass or other herbage until same was consumed by locusts, there is a possibility that the said germs might pass to human beings using the insects for food, though the possibility seems to be too remote for consideration; at least the danger from contagious diseases through eating locusts is an absolutely negligible idea, provided the locusts are roasted or otherwise cooked before eating).

Rolling.—In young cogon grass on level ground a section of buri-palm trunk, or a straight smooth log, at least 40 and better 60 centimeters in diameter, drawn by carabaos or cattle, attached to either end, may be used to crush the loctones with considerable success.

Burning.—Where the young hoppers are hidden in grass and brush on rough ground, it is sometimes feasible to cut the herbage over the infested area and set fire to it as soon as it gets dry enough to burn. This, of course, will also apply to an area in which it is definitely known locust eggs are about to hatch. As soon as the locusts appear and collect upon the dried grass and brush they may be almost completely destroyed if the material for burning be in fair quantity. The burning method is particularly practicable in the cogonales in uncultivated districts; the great amount of labor necessary for cutting the grass is the principal objection to this method, while another is the fact that it can seldom be used in the rainy season.

In some cases the swarm, if well concentrated in a dense line, may be quickly destroyed by the use of a special apparatus using a burning jet of petroleum; an ordinary spray pump with the nozzle fastened to the end of a pole about 2 to $2\frac{1}{2}$ meters in length may be converted into a powerful burning torch which is effective even in rainy weather; the flame from this burning jet will readily penetrate any cogon grass or brush. Any surplus oil which may escape the jet flame continues burning on the insects or herbage. The objections to this method are the cost of the petroleum and the danger from burning accidents when the apparatus is in the hands of inexperienced operators.

Insecticides.—Locusts in any stage of development may be killed either by contact sprays or by poison solutions. The simplest method is perhaps kerosene, or any of the light crude petroleum oils, used as a direct-contact spray. In or near barrios

where there are valuable crops it is in many cases practicable to spray the insects with kerosene, using cheap hand pumps, the kerosene being carried in metal buckets or even in the original tins; this may also be used very effectively upon voladores while roosting at night, though it is much more effective on the young loctones.

For general field work, however, the kerosene-spray method can not be recommended very highly on account of its expensiveness; a modification of this, known as the kerosene-emulsion method, is very much cheaper and may be used very advantageously on young loctones. This emulsion is made by mixing kerosene with soap and water to form a dilute mixture or emulsion, the soap holding the kerosene in suspension; even very dilute mixtures are effective against the very young loctones. One of the authors has carried out numerous experiments with various arsenical poisons and the results have been published in a previous number of the REVIEW.[1]

Unfortunately the use of arsenical poisons is usually attended with serious danger for the following reasons: (1) The Philippine planters are unfamiliar with poisons and the methods of using them; (2) there is always more or less danger of poisoning domestic animals through their feeding upon the poisoned grass; (3) many beneficial birds which normally feed upon locusts might be destroyed by eating the poisoned insects. In special cases, however, such poisons as lead arsenate, or a sweetened mixture of white arsenic, may be used by experienced persons with very good effect.

Inoculation.—There are two or three diseases known to attack the migratory locust, one being a fungus (*Empusa grylli*) which has been used with some success, it is said, especially in America, to artificially inoculate these insects. It appears, however, that only under very favorable conditions does this disease spread with sufficient rapidity to cause the destruction of large numbers of the insects and, therefore, considering the expense and precariousness of the results, the artificial propagation of this fungus can not be recommended for general use. It is possible, however, that sometime some bacillus, bacterium, or fungus germ disease may be discovered which can be cheaply and readily handled by means of laboratory cultures so that entire swarms may be exterminated by means of the contagion spreading from inoculated individuals to the entire swarm. Thus far the theory

[1] "An Investigation of the Locust Pest in the Philippines." PHILIPPINE AGRICULTURAL REVIEW for 1910, Vol. III, No. 4, pp. 231–240.



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(*a*) Egg destruction—tamping the ground with mauls.



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(*b*) Maize field—showing effect of locust attack.



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Locust breeding cages at insectary, Singalong Experiment Station, Manila.



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Coconut leaves breaking under the weight of "voladores," or adult locusts, Province of Cebu.

regarding these inoculatory remedies is excellent but the practice is not only discouraging in its efficacy but very expensive and difficult.

Natural control.—Rainfall is undoubtedly the principal feature of the natural control of migratory locusts. There is no question but that vast numbers of young hoppers are destroyed by heavy rainfalls, especially if these occur just after or during a moulting period or at the time of hatching. The water adhering to the surface of the body drowns, or rather suffocates, the young insect almost as much as if it were immersed in a stream. Of course, if the insects have reached the winged state, the wing-covers serve to protect most of the spiracles, or breathing pores, on the sides of the abdomen.

As an instance of the destructive effect of heavy rainfalls may be mentioned the case at Alcala, Pangasinan: On August 9, oviposition occurred over a vast cogon area in that place, the average number of egg clusters per square meter being about seventy; on August 10 a very heavy rain caused this area to become thoroughly soaked and even partially inundated by the overflow of the Agno River. A deposit of silt brought by the flood occurred over a considerable part of the oviposited area, thus covering the clusters to a depth of several millimeters with a nearly air-tight paste of fine mud; on September 5 an inspection of this area revealed the fact that only a very small percentage of the eggs had hatched, or at least there were but very few of the loctones in evidence, the rest almost certainly having been suffocated in the egg burrows. The presidente of Alcala stated that only three gantas of loctones had been destroyed in this locality, although the finding of hundreds of cavans was, of course, to be expected. It is believed that practically all of the submerged egg clusters were destroyed, the few hoppers in evidence, it would appear, having come from the elevated portions of the areas which were not reached by the flood; thus, reckoning 60 eggs per cluster, or 4,200 per square meter, the average number of locusts which normally would have appeared in one hectare is upwards of forty millions, or probably some billions of insects in the entire area; each one of these insects, except for the rain and flood, would have probably destroyed at least half a kilo of herbage during its lifetime. (According to H. Maxwell Lefroy, chief entomologist of India, a migratory locust consumes about 300 times its own adult weight in food.)

It appears that not only do heavy rains kill outright the eggs and very young loctones, but even excessive moisture in the soil

during the incubation period seems to reduce considerably the vitality of the young insects. To prove this, various experiments have been conducted by the writers. It was found that submerging egg clusters for three days affects the vitality of the eggs considerably, while four days under water results in the destruction of about 25 per cent, and six days' submergence completely destroys all the eggs in the cluster. More interesting still, perhaps, is the fact that egg clusters thoroughly drenched daily with water but not submerged therein, produced weak young loctones, none of which lived for more than eight days after hatching, and some for only one day, the degree of vitality depending apparently upon the amount of wetting the clusters received during incubation.

Winds unquestionably destroy swarms of voladores when venturing to cross from one island to another. Several cases of swarms having been drowned in the sea have been reported to this office. It appears that any head wind seems to demoralize the swarm which, clinging firmly at first to its instinct of proceeding in a certain direction, may become confused at being swept out of the chosen path and not realizing the danger beneath, settles upon the water to await a more favorable condition. They are, of course, quite unable to rise from the water once having touched it.

Predaceous enemies.—Under this head may be classed birds (including poultry), domestic animals, such as dogs and pigs, and insects. The cannibal habits of the locusts are in many cases a very important feature; in case of the injury of an individual or even the extreme hunger of the swarm, this tendency to devour one another is strongly brought out; this characteristic is of great importance in using arsenical sprays, for as soon as the first insect in the advance of the swarm becomes affected by the poison he is devoured by his companions, which, of course, are also killed by the poison contained in the first body and so on for at least three, if not four, cycles.[1]

Although domestic fowls frequently destroy comparatively large numbers of young locusts when present in the neighborhood of barrios, they are not an important feature in locust destruction. By the same token, pigs, both wild and domestic, dogs, etc., are only apparently in some cases of economic value as consumers of locusts. Wild birds, however, are of more importance than is generally believed for they, from the very

[1] For details see "An Investigation of the Locust Pest in the Philippines." PHILIPPINE AGRICULTURAL REVIEW, 1910, Vol. III, No. 4, pp. 227–240.

first appearance of the young locusts as they issue from the ground, wage a continuous warfare upon the swarm. The following list of Philippine birds represents the most important locust destroyers so far as known at present:

LUZON SHRIKE (*Otomela lucionensis* L.). This bird ranges from Mongolia to Celebes and is usually very common in the Philippines during September and October. It is a voracious insect eater and is, therefore, one of the most valuable birds to the Philippine planter. On account of its habit of perching on fence posts, dead branches, etc., it is very often trapped or snared, against which acts on the part of thoughtless or ignorant people it should be protected by law.

CARABAO BIRD (*Bubulcus coromandus* Bedd.). This white heron is of very wide distribution, being found from Eastern Siberia to the East Indies; it is particularly fond of the society of the carabao, probably on account of the good feeding which it usually finds in the propinquity of these animals. While they readily eat small frogs, snails, etc., their principal diet is insects, such as locusts.

KINGFISHERS. The three species of this family (*Alcedinidæ*) of the Philippines are expert insect catchers, though, of course, their principal food is fish, frogs, crabs, etc., found along the streams which they frequent in preference to pastures. They do not follow locust swarms to any great distance although the largest (*Halcyon gularis* Kuhl.) is frequently found at a long distance from water courses. The other *Halcyon* (*H. chloris* Bedd.) prefers the tide flats and canals, though, when locust swarms approach its haunts, it readily feeds upon the loctones. The smallest of the Philippine kingfishers (*Alcedo bengalensis* Briss.) is a rarer form, and, therefore, of no great importance as a locust destroyer.

VARIEGATED CURLEW (*Numenius variegatus* Scop.). This bird sometimes follows locton and locust swarms in the grass lands and individually destroys a considerable number of locusts. As the two other species (*N. arquata* and *N. cyanopus*) are also of the same habits, it is safe to assume that they, too, destroy numbers of the pest.

GOLDEN PLOVER (*Charadrius fulvus*).—This beautiful bird often frequents the grassy uplands and commonly includes locusts in its diet.

BUTTON QUAIL. Two species of these birds (*Excalfactoria lineata* Scop. and *Turnix fasciata* Temm.) are known to be locust feeders, although the stomachs of the specimens examined contained only non-migratory species.

JUNGLE FOWL (*Gallus gallus* L.). While this bird is preëminently a denizen of the forest, it greedily devours locusts when appearing in its haunts.

COMMON ROLLER (*Eurystomus orientalis* L.). This bird is almost exclusively insectivorous, and, though its principal diet is beetles, it devours large numbers of locusts whenever possible.

BEE EATERS. Two species (*Merops americanus* Mull. and *E. philippinus* L.) are excellent destroyers of locusts. The few stomachs examined thus far indicated that several species of locusts and grasshoppers together with other grass insects formed their almost exclusive diet.

Insect parasites.—There probably exist in the Philippines today a number of species of parasites, both Hymenopters and

Dipters, which more or less affect the swarms of locusts especially in the interior districts. There has been no time, however, thus far, for the writers to make a thorough study of this important phase of locust destruction work. Laboratory experiments along this line are always tedious and difficult, and, while potentially important, must, under ordinary circumstances be laid on the table, so to speak, until time permits further investigation.

INFESTED AREAS.

The accompanying map (fig. 5) indicates the localities in which migratory locusts have appeared during the present season from June to November 1. The suspected permanent-breeding areas are included with the areas known to be infested for the reason that this hidden source of the stream of migratory locusts which has been for decades, if not centuries, devastating Philippine crop areas must be fully appreciated to fully understand the status of the pest to-day. The present season has been an abnormally bad one for the Philippine planters, largely on account of the remarkably long period of drought preceding the present period of outbreaks. Throughout the world dry years are notoriously bad locust years.

It was suspected at first that large swarms had emigrated from the cogon fields of the interiors of the larger islands in the Visayas on account of shortage of green food therein to the almost immediate destruction of very rich crop areas, especially in Leyte, Bohol, and Cebu; a careful study of the situation indicates, however, that most of the present trouble can be traced back to the swarms which left Bohol, probably from the sparsely populated central or northeastern portion of the island about the middle of May, crossing the straits to Dalaguete and southeastern Cebu, and finally traversing and ovipositing over nearly the entire length of the latter island. According to reports received by this office in 1911, Cebu was quite free from locust infestation. In the course of two generations the Cebu outbreaks have furnished swarms which crossed in August or September to Negros. The precise origin of the Samar and Leyte swarms remains in doubt, but it is believed that they originated respectively in central Samar and Northern Leyte. As previously stated, central Mindanao is, and probably will continue to be, a menace to the Visayan Islands, since in the vast plains of the hinterland of that Island countless swarms of these insects can breed with only the elements and a few natural enemies to interfere.

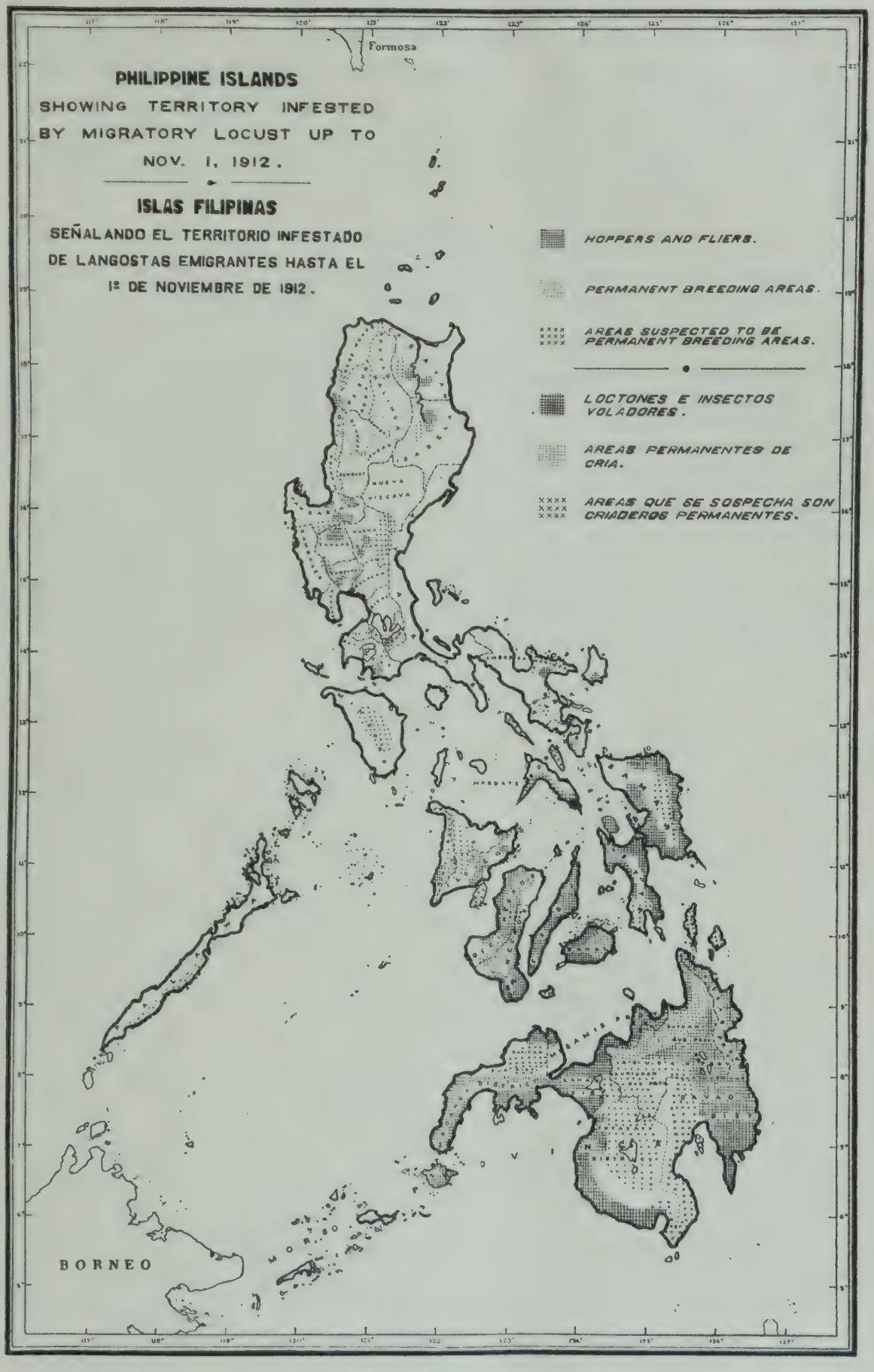

Formosa
PHILIPPINE ISLANDS
SHOWING TERRITORY INFESTED
BY MIGRATORY LOCUST UP TO
NOV. 1, 1912.
ISLAS FILIPINAS
SEÑALANDO EL TERRITORIO INFESTADO
DE LANGOSTAS EMIGRANTES HASTA EL
1º DE NOVIEMBRE DE 1912.
HOPPERS AND FLIERS.
PERMANENT BREEDING AREAS.
AREAS SUSPECTED TO BE PERMANENT BREEDING AREAS.
LOCTONES E INSECTOS VOLADORES.
AREAS PERMANENTES DE CRIA.
AREAS QUE SE SOSPECHA SON CRIADEROS PERMANENTES.
BORNEO

Fig. 5.

SUMMARY.

During the past six months migratory locusts are believed to have destroyed upwards of ten million pesos worth of crops, fully 90 per cent of which damage was done in the Visayas.

The origin of these locusts appears to have been in the Visayas, Bohol and possibly Samar and Leyte, evidently harboring the pest from the past year.

Only by coöperation on the part of the local planters with the locusts boards in each province and with the principles laid down in the rules and regulations furnished by the Bureau of Agriculture, can the pest be fully controlled. Now that the effectiveness of these measures, which have been recently put to the test in some fourteen or more provinces on a large scale, is widely known, and with the much better understanding of the entire situation and its means of control on the part of the municipal presidentes, tenientes of barrios, and the planters themselves, it is believed that the provincial locust boards and the Bureau of Agriculture will have very much less difficulty in maintaining control, if not in actually accomplishing the complete extermination of the pest.

THE MANUFACTURE OF PAPER FROM ABACÁ.[1]

By M. M. Saleeby, *Chief, Fiber Division.*

It is interesting to review the circumstances that led some American manufacturers to use abacá (Manila hemp) in the manufacture of paper. The origin of this industry dates back to the Civil War, prior to which cotton bags were almost exclusively used for transporting flour and various other articles. During the war the production of cotton fell to an alarming extent and consequently its price advanced to such a high point that the use of cotton bags was rendered very expensive and it became necessary to look for a substitute. Strong paper was at once decided upon as the required substitute, and it was not long before abacá, in the form of old rope, was concluded to be the most desirable raw material for making such a paper. The manufacture of this paper, known to the commercial world as "Manila paper," was found to be so satisfactory as to strength and other requisites that it has ever since become a competitor of cotton in the manufacture of bags for transporting flour, cement and other similar commodities. Since the Civil War the production of cotton has increased to an enormous extent, but at the same time its price has been gradually rising, owing to the simultaneous increase in the number of uses made from it. This fact, together with the rapid development of the interstate commerce and the wonderful increase of its volume, have served to establish on a permanent basis the Manila bag industry.

Among the requisites for desirable bags such as are used for the purposes referred to above, strength, durability, and low cost are the most essential. As to the first two requisites Manila bags are in some respects superior to cotton bags. In the interstate trade, for instance, in which railway and other means of transportation are used, the former has proved to be as strong

[1] Acknowledgment is hereby made to Mr. H. B. Pond, of The International Purchasing Company, for giving valuable suggestions relative to some points discussed in this paper.

and durable as the latter, besides being also less permeable to a limited exposure to moisture. In foreign trade, however, in which steamships are the only means of transportation, cotton bags are superior to Manila bags, because of their pliability which renders them more fit to stand the rough handling to which they necessarily have to be subjected. As to the third requisite Manila bags are preferable to cotton bags, and are substituted for them in most cases in which the cost is an essential feature.

Manila paper bags are now manufactured in different sizes and of different degrees of strength. They are designated according to their capacity, the largest being strong enough to hold 50 kilos each, and some even more.

Besides being used in the manufacture of bags, Manila paper, owing to its superior strength and toughness, is also being used in the manufacture of sandpaper and for insulating purposes. The so-called Manila paper used for making ordinary paper bags and wrapping paper for use in grocery stores, is generally made from wood pulp or jute, and the term as it is thus applied is therefore a misnomer.

About the year 1900, or perhaps a little earlier, it was discovered that the supply of old Manila rope would in a few years be insufficient to meet the growing demand. Again the paper manufacturers resumed the search for some other raw material that might be used along with old rope. Sisal, which ranks second only to abacá as a cordage fiber, was subjected to several experiments but the results proved that it was not suitable. Jute butts were similarly tested and, while they gave better results than sisal, their use was, for the most part, restricted to an adulterant for old Manila rope, as it was found that they lacked the required strength. In 1902 and 1904, which is either shortly before, or shortly after, the time covered by the above tests, the Bureaus of Agriculture and Science of this Government were conducting extensive experiments in the manufacture of paper from abacá waste. The results here, as well as in the United States and Europe where samples were forwarded and similar experiments made simultaneously with those conducted here, were at the time thought to be so encouraging that it was only a short period afterwards that paper manufacturers in the United States began to place orders for small quantities of this waste in order to conduct more exhaustive tests. The ultimate result of these tests confirmed the preliminary ones in that the waste was suitable for the manufacture of Manila

paper, but the percentage of pulp from it was lower than that obtained from old Manila rope, and consequently the price offered for the former was entirely governed by that of the latter.

Thus the preparation and exportation to the United States of abacá waste for the manufacture of Manila paper began, practically speaking, in 1905 and continued until the end of 1911,[1] during which period considerable quantities were shipped, running at times as high as eight thousand bales per month. The cost of this waste to the manufacturers, laid down in New York, has been as high as the value of old rope, which means that it has been used all this time at a considerable loss to the manufacturers, who bore the loss this long in the hope of building up this new industry to such an extent as to encourage a more general production and the ultimate installation of the necessary machinery for reducing the waste to pulp here in the Islands in order to save the excessive freight and other charges on the raw-material from Manila to New York. All efforts directed toward the realization of this hope were thwarted, however, for experience and continuous trials have revealed many difficulties that proved impossible of solution. These difficulties are briefly the following:

First, as mentioned before, the percentage of paper pulp from the waste is lower than that obtained from old rope, and, therefore, it would be impossible to continue paying the same price for the former that is paid for the latter.

Second, the quality of the waste has been found to be extremely variable, depending on the quality of the commercial fiber produced in the same locality. In all the provinces where transportation and other necessary facilities can be obtained, the quality of the waste is very bad, owing to the inferior grades of the commercial fiber produced there.

Third, owing to the difficulty of drying the waste during the rainy season which covers the greater part of the year in most of the abacá districts, to the cost of transporting it to a provincial shipping port, to the cost of baling at the latter place and freight charges to Manila, and also to the freight and other charges connected with its shipment from Manila to New York, the cost of the waste to the manufacturers was prohibitive.

During the last year the provincial buyers paid from 4 to 5½ centavos per kilo, and they themselves received for it in Manila

[1] It is possible that abacá waste is still being produced, but, if so, it is only on a small scale, pending the outcome of recent developments mentioned later on in this paper.

an average of about 7 centavos. The cost of the same laid down in New York ranged from about 10 to 13 centavos per kilo, or about the same as old Manila rope. Thus it is plain that all parties concerned in the transaction either lost or were left with a very narrow margin of profit that hardly justified the trouble. Thus the abacá-waste industry, which began six or seven years ago with good prospects, ended in failure in spite of the liberal application of the necessary tests and inducements.

The experience gained in the attempt to build up the abacá-waste industry tended to strengthen the belief of the paper manufacturers in the suitability of the abacá fiber rather than to weaken it, and, as a result of this belief, we are pleased to note a recent development in the utilization of the abacá fiber, which is destined, on the one hand, to solve the difficulties encountered in the preparation, drying, and transportation of abacá waste, and on the other, to supply enough quantities of the raw material which, combined with old Manila rope, may prove sufficient to meet the increasing demand. We refer to the new "crusher" introduced by Mr. G. D. Adams, vice-president of the Cleveland Akron Bag Company, of Cleveland, Ohio. Mr. Adams represents the International Purchasing Company, which is formed by the leading paper manufacturers in the United States, and he is capably assisted here by Mr. H. B. Pond, manager, The International Purchasing Company, in this city. Three crushers of different sizes and capacities have already been introduced and are intended for trial operation in localities where abacá is extensively grown.[1]

This space does not allow of a full description of the construction and operation of this new machinery; besides, it is more advisable to wait until more elaborate tests have been made and the results more definitely demonstrated. It suffices here to say that these crushers handle the entire abacá stalks in exactly the same manner as sugar cane is handled. The crushed fiber and pulp come out fairly dry and are lifted up 10 or 15 meters and then dropped into an ingeniously constructed drier where in two or three hours the crushed material becomes so dry that the pulp can be easily shaken away from the fiber. The writer witnessed one of the trial operations of this new crusher and drier in this city and believes that the results were entirely

[1] It has been learned since that the largest crusher has been installed in Albay Province and is expected to be placed in operation in a short time.

satisfactory and encouraging. It is the intention of the above company to install these mills in those localities where, owing to the unsatisfactory growth of abacá and to the unwillingness of the planters or laborers to turn out good grades of the fiber, very low profits, if any, are now being realized. There it is believed the abacá stalks can be bought cheap and the planters will, at the same time, make higher profits from their plantings by selling the entire stalks than they are at present making by preparing the fiber the way they do. This, it is also hoped, may stimulate the abacá industry by forcing out of the market those inferior grades for the existence of which there can be no reason or excuse.

It is earnestly hoped that the abacá planters in the localities where the above machines are to be installed will coöperate in giving a fair chance and encouragement to this new phase of the abacá industry, trusting that the results will prove beneficial to all parties concerned.

NOTE.—The above article was submitted in July, 1912.

SELF-STERILITY OF THE SCUPPERNONG AND OTHER MUSCADINE GRAPES.

By P. J. WESTER, *Horticulturist.*

Notwithstanding the great number of excellent fruits grown in the Philippines, many residents from the Temperate Zone frequently inquire if the fruits to which they have been accustomed at home can not be grown here—among others the grape.

Grapes, *Vitis vinifera* L., were long ago introduced by the Spaniards and as a "survival of the fittest," a pale-green variety with small bunches of fruit is being grown to some extent in Cebu and is also found in Negros, Siquijor, and in several towns on the north coast of Mindanao. Grapevines are also found in Manila, and probably in other parts of the Archipelago.

While there may be some varieties of vinifera grapes that may become acclimatized in the Philippines it is probable that the Muscadine grapes, *Vitis rotundifolia* Michx.—the climate of whose home more nearly approximates that of the Tropics than does the climate of the home of the European grape—are likely to succeed better here than the European. In anticipation of the introduction of several of the best varieties of the Muscadine grapes which has been arranged for by the Bureau of Agriculture, the experience had with the Muscadine grape, in southeast Florida, in a climate similar to that of the Philippines, may not be without interest. There numerous varieties of the American, European, and Muscadine grapes have been tried repeatedly. In general the varieties of the American grape have been most disappointing, and practically all the European varieties have been failures, but the Muscadine grapes that have been tried, such as the Scuppernong and Thomas, have made an exceedingly satisfactory growth.[1] However, they proved to be very unfruitful and for want of a better reason, the climate and soil were blamed. Judging from the results

[1] *Vitis rotundifolia* Michx. is indigenous to South Florida.

obtained by F. C. Reimer and L. R. Detjen at the North Carolina Agricultural Experimental Station, in their observations and experiments relative to the pollination and fertilization of the flowers of the Scupperong, Thomas, and several other varieties of Muscadine grapes, summarized in Bulletin No. 209 of the station, the primal reason for the unfruitfulness in the Muscadine grapes would now seem to be self-sterility.

The work of Reimer and Detjen included: Germination tests of pollen; microscopic study of pollen; study of the structure of the flowers; study of the influence of male vines on the crop growing in close proximity to the fruiting vines; and pollination experiments and bagging tests.

In the pollination experiments pollen from the Scuppernong and the James was applied to stigmas in flower clusters of the Scuppernong with the result that no perfectly formed berries developed, proving that the Scuppernong is self-sterile and also that pollen from the James variety, typical of the other Muscadine grapes, is ineffective on the Scuppernong. In the germination tests of pollen of thirteen varieties of Muscadine grapes and several wild fruiting vines of this type, pollen in no instance germinated; pollen from male vines, similarly treated, germinated well in three to four hours.

The germination tests, as well as the observations made in a microscopic study of the pollen, combined with the results obtained in the bagging and pollination experiments, show that the pollen of the Muscadine grapes examined, Scuppernong, James, Thomas, Flower, Mish, Memory, Flowers Improved, Hopkins, Tenderpulp, Luola, Labama, San Jacinto, and San Melaska, is worthless and these varieties are, therefore, self-sterile. As a result, interplanting of these varieties will *not render them more prolific.* Their productivity can be increased provided soil, climatic and cultural conditions are favorable *only by planting among them, or in their close proximity, male vines.* The value of male vines growing near the fruiting sorts was strikingly illustrated in the course of this investigation; in one instance, in a Scuppernong vineyard in which there grew male vines, the yield was *five times greater* than in another vineyard on the same farm that contained no male vines. It was also noted that honey-bees and certain flies are active as pollinizers.

In order to make the planting of male vines effective near the cultivated Muscadine vines, care should be taken, of course, to see that the two vines flower at the same time. Those who

are familiar with the structure of the flowers of the grape, may, where the Muscadine grape grows wild, obtain material during the flowering season for interplanting from wild male vines which occur in the hammocklands; in other countries male vines must be obtained from someone who has them for sale.

The different varieties of Muscadine grapes would be distinct and welcome additions to the cultivated fruits in the Philippines and they are very likely to succeed here. Those who may contemplate their planting should, however, not forget to also plant a few male vines in the vineyard.

THE BICOL FARM.

By E. H. KOERT, *Agricultural Inspector.*

Soon after the arrival of the representative of the Bureau of Agriculture in Virac, Catanduanes Islands, on January 11, 1911, it was found that the keeping of stallions and other animals for breeding purposes within the limits of a town or village was at the best a very unsatisfactory arrangement. The conditions making it so were principally expense, poor stabling, lack of proper exercising and working grounds, and the difficulty of securing grass. The only remedy was the establishment of a small farm by the combined efforts of the three municipalities of Virac, Bato, and Calolbon which constitute the southern part of Catanduanes Island. The matter was discussed with a number of the leading citizens of Virac and a plan was formulated which was then submitted to several persons from the towns of Bato and Calolbon and upon having met with their approval it was adopted. This was that the towns of Bato and Calolbon were to furnish the necessary funds while Virac's share was to be given in labor and materials. For securing the necessary appropriations in Bato and Calolbon the principal credit is due Messrs. Eusebio Tejada and Capt. Braulio Tapular, respectively.

The land to be purchased not possessing a Torrens title, considerable difficulty was encountered in securing the necessary approval for the expenditure of municipal funds, but the whole matter having been laid before the Governor-General on the occasion of his visit to Virac, October 1, 1911, His Excellency approved of the project. Approval once secured, arrangements were made for the construction of the stable. During the month of November, 1911, the work was started and New Year's Day, 1912, witnessed the occupation of the farm. In connection with this it is desired to say a few words in appreciation of the assistance given the writer by various residents of Virac. The president of Virac, Sr. Margarito Surtida, did yeoman service in securing the necessary materials and labor for the construction of the stable; the vice-president, Sr. Pedro Alberto, gave

his services in the supervision of the construction work; Sr. Eustaquio Joson rendered invaluable services in holding meetings in the various barrios to secure the prompt furnishing of materials and the attendance of laborers. Still another, Sr. Isidro de la Hostia, has at all times shown a helping hand and only recently donated a small strip of land in order that the farm might be rectangular in shape.

During the month of July, 1912, a representative of the Bureau of Lands surveyed the farm and found that it contains a trifle over $2\frac{1}{3}$ hectares.

For lack of authority to employ sufficient labor but little progress was made until March 31, 1912. Then the fencing was begun and pushed until the whole plot was enclosed by a stake fence, the only kind that could be built with the limited funds available. The necessary stakes were cut on the farm and on adjoining land.

In the meantime some guinea-grass roots which had previously been received from Manila and planted were transplanted to the first land cleared. As soon as another patch was cleared cowpeas and corn were planted. The numerous carabaos at pasture nearby have so far destroyed three crops of corn by breaking down the fencing at night. It has nevertheless been possible to raise sufficient cowpeas to have not only considerable for use but enough to distribute in small lots. They are greatly appreciated by the people and withstood the long dry period nicely. On account of its habit of growing continuously, the cowpea has locally received the name "La habichuela aprovechable."

Since the rains have set in the plantings of guinea grass have been extended until nearly half a hectare is planted to it. Not only have the horses had their daily ration but it has been possible to furnish roots in small lots to a large number of people.

Some small progress in the introduction of vegetables has also been made. Instead of furnishing seeds to the people direct the following policy has been adopted: A stock of seeds being on hand practically all the time, these were distributed to the teachers with the understanding that the seeds were to be planted in the seedbeds of the school gardens and the plants grown were to be available to anybody in the district asking for them, thus avoiding the loss of seed that generally results from lack of knowledge in securing proper germination, etc. The "Roselle," but recently introduced by the Bureau, has already won fame

in this island, being greatly appreciated as a salad plant, and its further benefits and uses may become known to the people through the domestic science class of the subprovincial school. Since the opening of the school a small plot has been turned over to the barrio school near the Bicol Farm and a model garden has been laid out by the students under the direction of Mr. Antonio Amata who had excellent results last year in raising vegetables and also in the manufacture by his students of agricultural instruments.

Some work in the way of horticulture is also being taken up and it is hoped that before the rainy season is over satisfactory progress may have been made.

Above all the principal object in the acquisition and improvement of the farm was, to provide better conditions for breeding stock, and to provide facilities for the people so that they might leave their animals at the farm for breeding and treatment. The pasture, although in poor condition till lately, has recently been planted to Bermuda grass and this promises to do exceptionally well under local conditions. The pasture has been of great benefit and help as a place for keeping the numerous horses that are being castrated, it being possible to leave the animals on the farm for a day or two with no extra labor to speak of and without causing expense to the owner.

AGRICULTURAL CONDITIONS IN BOHOL.

By E. F. SOUTHWICK, *Agricultural Inspector.*

GENERAL FEATURES.

The Island of Bohol is to a great extent of coral and volcanic-rock formation. The soil for the most part is clay, varying from a "gumbo" in the southern end of the island to a sandy loam in the northern part. From Mabini to Inabanga by way of Tagbilaran a range of hills follows the coast and extends inland to the towns of Bilar and Batuan where the country stretches out into a level plain, including the towns of Carmen,



Fig. 6. Map of Bohol.

Sierra Bullones, Ubay, Talibon and Getafe, broken only by a small range of hills extending from Mabini to Talibon. A great portion of the mountain region is rocky and rough, but even here are found many fertile valleys small in area, but capable of producing good crops.

One of the finest sections of Bohol now under cultivation is between the towns of Tubigon and Calape. It is some seven

kilometers in length and not over 3 kilometers at the widest place. It is here only that sugar cane is raised to any considerable extent. The northern plain in the vicinity of Ubay and Talibon is given up entirely to stock grazing. The central plain around Carmen and Sierra Bullones, which is perhaps the most desirable agricultural land of Bohol, is entirely undeveloped on account of being inaccessible.

Very little advance has been made as yet in the use of modern tools or practices and the native plow undisputedly holds the center of the stage in agricultural operations. On only one farm has the writer seen modern implements in use.

CORN.

Corn is grown very generally throughout the island and constitutes the principal food of the people. Inabanga and the surrounding country takes the lead in the production of this crop. It is grown both on the hill-sides and the plains, and in fact on all cultivated land that is not particularly suited to rice growing. Three crops a year are harvested, provided the year is a normal one. The quality of the corn is good as corn runs in this section of the island.

The method of preparing the land and of cultivating the corn is practically the same as that followed in other parts of the Islands. The soil is generally plowed once or twice with the native plow then furrowed and planted. This is not always the case, especially if corn is to follow palay, when the stubble may not be turned under but furrows simply made and the corn planted; this is also done where corn follows corn, not even the stalks of the former crop being cut down, though this practice is not common. The cultivation after the crop is up varies from one to three times, being done with the plow and usually carried to the same depth as an original plowing. The number of cultivations depends chiefly upon the growth of the weeds. If the weeds grow rapidly then the crop gets a greater amount of cultivation. Where a carabao is not to be had or where it is impossible to work such an animal the bolo is used for cultivating the crop, and in difficult places, even for preparing the land for planting. In the preparation of the soil a bar is customarily used on such land.

The seed for planting is usually taken aimlessly from a pile of shelled corn, and seldom is any attempt made at selection. In some cases only kernels with a large chit or germ are selected. From three to five kernels are planted to the hill, and the hills

are approximately a meter apart each way. In very few instances can a farmer be found who does not go over his field and replant all missing hills. Thinning is not practiced, and although this is an important feature it is less so than replanting. The custom of eating "roasting ears" and boiled corn is a hindrance to good seed selection, especially in a season like the present when the people are depending upon this for food. The ears chosen for this purpose are those first to mature and of greatest size, which would be the ones selected for seed at a later date. This would not be true to such a degree where a man had several hectares planted to corn, but is true with the small farmer. There are sections here where the corn is mixed to a large extent with both red and yellow varieties.

In spite of the fact that 25 per cent more corn was planted in June and July than is usually planted and that the past season has been a good one, the crop was practically a failure. This was due to the vigorous attacks of a large swarm of locusts that has been moving about since the first of June. In many towns the entire corn crop was wiped out, while in other places the damage amounted to not over 20 per cent. Certain sections have been planted three times without results.

RICE.

Rice is grown as generally throughout the province as corn. This is made possible by the large number of small streams that are found here. These streams although usually dry during a drought are used along their entire course during the rainy season to irrigate rice paddies. The paddies are small in area and constructed in terraces so that the water flows from one to the other. Many of the fields are poorly irrigated and depend almost directly upon the rainfall for water. Such paddies are often severely injured by a short drought, or as was the case during the present year, by locusts, which will not touch palay when flooded but make short work of it when dry.

The preparation of the soil before the palay is planted is very thorough and could the farmer be induced to prepare his corn field in a like manner the resulting crop would tell a very different story. All work is done while the paddy has enough water on it to cover the ground. The soil is first plowed and then several carabaos abreast are driven over and over it until a thin soft mud is produced. Much care is taken to have all the edges and corners in as good condition as the middle. After a thin soft mud is obtained a bamboo harrow is used followed

by a sort of plank leveler. These are dragged around and around until the ground is perfectly level throughout so as to facilitate an even distribution of water.

The seed is planted very thickly in drills on dry soil, often between rows of corn, and when it attains a height of 10 to 20 centimeters it is transplanted by hand to the paddies. In transplanting the leaves of the plants are cut back. Where a large area of paddies is to be planted several sowings of seed are made so that the plants will be right for transplanting as the fields are ready. Soon after the plants have become well established they receive the only cultivation which they get. This is done by stirring the soil around the plants with the hand or bolo.

The best irrigation system on the island is in Lila. This consists of a considerable area of land irrigated by water obtained from a constantly flowing spring in the hills.

TOBACCO.

Tobacco is not as important a crop here as it should be. Much of the leaf that is used in the island is imported. Inabanga produces a larger amount than the remainder of the province. It is claimed that in most towns it is not only difficult to produce, but the flavor of the leaf is not liked by the people.

SUGAR CANE.

With the exceptions of the towns of Tubigon and Calape very little sugar cane is produced in Bohol for the market. Nearly every town has a few hectares, but this is for home consumption only. In Tubigon there are two modern mills while the others are of the old two-roller, carabao type.

The 1912 crop is reported to have been at least 50 per cent less than an average yield, due to the drought. For this same reason almost no new plantings were made. Although the fields started up well after the rains of July they have been greatly damaged by locusts. In a few cases this will prove fatal and will cause a severe set-back and a reduced yield in 1913.

COCONUTS.

Coconuts are found in all parts of the province excepting the extreme interior where the number is very limited. The most extensive cultivation is found along the south coast, and here many of the towns get their chief income from the coconut tree.

Copra and tuba are the principal products, the latter finding a home market while the copra is bought by local agents and goes

to Cebu. Very little of the copra is dried over a fire, most of it being cured in the sun on native mats or burlap.

The coconut trees in many parts have been severely damaged the past year by both the drought and the locusts. Where the soil was shallow much greater effects were noted than where the soil was deep and more moisture available. In certain sections the people have been forced to eat the tender shoots of the trees, in this way destroying many. This together with those destroyed by the dry weather will cause somewhat of a decrease in the number of bearing trees. Many trees were also fruitless up to the time they felt the effects of the July rains when they flowered and set fruit.

New seedlings are constantly being planted in increasing numbers so the outlook for this industry is very bright at present.

ABACÁ (Manila Hemp).

Abacá is cultivated most extensively in the towns of Gindulman, Tubigon, Candijay, and Bilar. It is grown mostly on the hillsides and receives little or no cultivation. In spite of this fact mulching with the leaves is practiced very generally. No attempt is made at selection and far from the proper results are obtained. The stripping is done entirely by hand.

MAGUEY (Cantala).

This is a plant that is slowly losing its foothold in Bohol, due entirely to neglect. The plant does well in all parts of the province and there is no reason why it could not be raised with profit in many sections of the island, as the only attention maguey receives is to cut the leaves when they are mature enough for that purpose. The fiber is then removed by the "retting" system, which consists of stripping the leaves and placing them in salt water until the pulp softens. After this the fiber is separated by being beaten out with a piece of wood.

FRUIT.

Bananas, mangos, and papayas are grown throughout the province, Dauis and Panglao furnishing the best and largest quantity of mangos. Chicos and pineapples are produced only in limited numbers. Citrus fruits are very little grown as are also all other fruits. Guava is found wild in all sections but no attention is given to its cultivation.

VEGETABLES.

Camotes are produced in greater quantities than any other vegetable. Large areas are planted to this crop, especially this

season when fields of corn destroyed by locusts were immediately planted to camotes. In many instances they are set out in corn fields as soon as the corn has become well started. Besides being greatly relished by the people this plant is not attacked by the locusts. Mungos are raised to quite an extent in certain localities, but are usually planted among the corn and given little attention. On account of the scarcity of food considerable camoteng-cahoy has been set out. Ube, gabe, pao, tomatoes, and peppers are found almost everywhere in limited quantities. The high price of rice and lack of corn together with the locust pest caused more vegetables to be planted than is the general practice.

LIVE STOCK.

Cattle and carabao are found in fairly large numbers in the towns of Mabini, Ubay, Talibon, Getafe, and Sierra Bullones. Here are large areas of fine level grazing land supplying an abundance of the finest green forage. Many animals are shipped from these towns to neighboring islands. The protracted dry period caused the price of animals in these parts to drop off 50 per cent. Cattle are slowly finding their place as work animals and are sure to become recognized as such. The farmers who have tried them claim they are superior to the carabao in that they will eat dry fodder, such as dried corn and cane tops, and do not have to be taken to the water as do carabao. Besides this they are better in handling and accomplish more work. Horses are found in fairly good numbers but no thought is given to breeding, so little or no improvement is being made.

TRANSPORTATION.

The facilities for transportation in the Province of Bohol are of the poorest. The only practical means at the present time is by water. From Tagbilaran north to Tubigon there is a good road consisting of about equal parts first and second class. To the south from Tagbilaran to Gindulman there is also a good first and second class road broken at Loay by a bamboo bridge over the Loboc River. Heavy loads are not allowed to cross this bridge thus preventing heavy traffic in this direction. Everything carried to and from any of the interior towns must be "packed" by men. This utter lack of dependable transportation makes it impossible to ship products from place to place within the province. Now that the Tubigon–Carmen Road is an assured fact, one of the best agricultural districts of the island will be opened up in a very few years.

CURRENT NOTES[1]—JANUARY.

NOTES BY P. J. WESTER, Horticulturist.

AVOCADO OR AHUACATE.

We are in receipt of a very interesting pamphlet on the avocado by Mr. R. W. Popenoe, being a reprint from The Monthly Bulletin of the California State Commission of Horticulture. The author discusses the avocado with particular reference to the possibilities for this fruit in California. The part devoted to the propagation of the avocado is particularly timely. The statement that "lopping a young budded tree is dangerous" would seem to be somewhat overdrawn. It is true that the young avocado is more brittle than the citrus trees but this brittleness can be readily overcome with a little care in lopping the plants. In fact this has been used with good success by the writer in his fairly extensive experience in propagating the avocado.

We regret the necessity of having to take exception to Mr. Popenoe with reference to his proposal that the name "ahuacate" be substituted for the avocado. We admit that the word "avocado" is "reeking" with corruption, but we fail to see that "ahuacate" is either more beautiful, more euphonious, or more expressive of the flavor of the fruit. Were priority alone to be considered, the fruit in question has just as much claim, or even more, to the old Peruvian name "palta;" avocado is already in general use, however, and is near enough to the Aztec "ahuacate" to recall the connection—if that is necessary.

Next to being attractive and euphonious the points to receive consideration in adopting or coining a horticultural name for a plant should be those of the spelling and pronunciation of the name, about which there should be a minimum of doubt, and then as far as possible let priority rule. Both the American Pomological Society and the Florida State Horticultural Society have officially adopted the name avocado, and all recent publications of importance dealing with the subject refer to the fruit by this name. We doubt that it is good policy to try to switch off to another name now, in fact, we doubt if it can be successfully done.

[1] Original notes prepared by various members of the Bureau of Agriculture.

CANNED PINEAPPLES.

The following quotation from the Daily Consular and Trade Reports should be of interest to those who are engaging in pineapple growing and canning in the Philippines:

A firm in Germany informs an American consular officer that it is in the market for Hawaiian pineapples, or possibly the Porto Rican product in the event that the Porto Rican planters are in a position to pack their fruit for the trade. The fruit comes packed in cases of 24 and 48 cans, each containing one whole pineapple and of gross weight of 2½ or 3 pounds (1.13 to 1.35 kilos). The contents should be preserved in their own juice—that is, cooked without sugar—in order to enter at 4 marks (₱1.90) per 100 kilos. At present pineapples packed as above are received in the Hamburg free port, where the contents of the cans are emptied into barrels and the full barrels are thereupon passed through the customs. Under these circumstances it is not necessary to put fancy labels on the cans. The firm proposes to establish a bank credit at the place of shipment against which shippers can draw on the deposit of shipping documents.

ATMOSPHERIC NITROGEN AS A FERTILIZER.

Not so many years ago some of the world's foremost scientists scared us with the prediction of a nitrogen famine, and the rapid exhaustion of the world's supply of available nitrogen was a source of great concern. It was not long, however, until it was discovered that atmospheric nitrogen could be fixed by means of the electric arc and thus an inexhaustible storehouse was thrown open, so to say, to a famine-threatened humanity.

Soon the methods of the fixation of atmospheric nitrogen were improved upon and cheapened until it became possible to produce it in large quantities to compete with nitrate of soda and sulphate of ammonia. Norway leads in the manufacture of this new fertilizer, known as cyanamide or nitrolim, and if the plans of the Norwegian Hydro-electric Nitrogen Company mature, by the close of 1916, waterfalls in Norway to the enormous total of 540,045 horsepower will be utilized in the manufacture of nitrolim.

THE COLONIZATION OF SIBERIA.

Everybody knows of the emigration from Europe to the United States and Canada, and most well-informed people are cognizant of the emigration to South America, South Africa, and Australia, but few realize the extent of the colonization of Siberia which is taking place directed by the Imperial Government of Russia.

From January 1 to May 14, 1912, 144,265 Russian colonists entered Siberia. In 1911, during the same period, the immigrants numbered 127,000. The number who returned to European Russia during these periods was 69,997.

The department of agriculture and land settlement has recently worked out a detailed plan for the drainage of 24,000,000 hectares in the vicinity of the Amur River Railway.

THE COST AND PROFIT OF GROWING SUGAR CANE IN CUBA.

The following statistics relative to sugar cane growing in Cuba culled from the Agricultural News of Barbados should prove interesting to the cane growers in the Philippines. These statistics relate to the cost of preparing and cultivating one acre [1] of cane land per year.

Preparation of land.

Clearing land for plowing, from	₱3.00 to	₱20.00
First plowing, from	8.00 to	12.40
Second plowing, from	5.40 to	6.00
Harrowing, from	2.00 to	2.50
Cleaning and marking, from	2.50 to	3.30
	20.90	44.20

Cost of planting.

Seed cane, from	₱8.00 to	₱10.00
Hauling, from	1.00 to	1.40
Cutting seed-cane, from	1.00 to	1.60
Distribution of seed-cane, from	5.00 to	7.00
Covering, from	6.00 to	7.60
	21.00	27.60

Cost of cultivation.

First cultivation, from	₱8.00 to	₱9.00
Second cultivation, from	5.50 to	6.20
Third cultivation, from	3.20 to	4.00
Three cleanings, from	4.40 to	6.00
	21.10	25.20

Harvesting.

Cutting, from	₱25.50 to	₱36.00
Hauling, from	18.00 to	36.00
	43.50	72.00
Total	106.50	169.00

The cane needs replanting every six years and with the cost of cultivation reduced to ₱160 per acre per year during the five years subsequent to the first, the net profit to the grower in six years is ₱352.60, or ₱58.75 per year per acre, or ₱146.90 per hectare.

[1] 1 acre = 0.4 hectare.

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

CASSAVA FOOD PRODUCTS.

Few people in the Philippines realize the great possibilities of the cassava crop here. To be sure, it has long been cultivated under several varieties throughout the greater portion of the Archipelago, but either the varieties are inferior or more frequently, perhaps, the attention given the plants is such that a good crop of roots is seldom obtained.

Until the great rubber boom came into the Malay States, cassava was for many years a very profitable crop in some districts and even now there is a large acreage in this plant near Penang.

In South America, of course, the plant is of much greater account and in some countries, like Colombia and Brazil, it forms a very large part of the daily ration of the middle and lower classes. In Jamaica a new industry has recently sprung up in the line of making cassava wafers which are now exported to the United Kingdom and the United States. These wafers are made in several forms from the huge, coarse, "Bammies," consisting of the grated root with a little of the starch pressed out, made into thin sheets and toasted, or roasted, or fried, to the delicate "tea wafers" which for some time have been used at fashionable luncheons and afternoon tea-parties, especially in Boston. Nowhere is there anything else in the bread line quite so good, in my opinion, as hot buttered "bammies" fresh from the fire.

Not only the wafers, cookies, and cakes, but also the new breakfast foods, tapioca, flour, etc., made from the grated root treated in different ways, are bound to be popular; likewise the various kinds of sauces made by boiling down the juice from the grated roots, with or without salt and spices, etc. Of these latter, "cassareep" and several sauces like "Worcestershire" are now on the market not only in the West Indies but to some extent in Europe and America; these condiments possess the property of rendering meats very digestible and appetizing; they undoubtedly have a direct effect on the stomach itself, and in the near future will be appreciated very highly by threpsologists as well as cooks and housewives.

RATS IN COCHIN CHINA.

Cochin China, according to the American Consul at Saigon, is suffering very severely from rats in the palay fields. The average loss from this pest in some districts is as high as 30

per cent of the normal crop. Reckoning the average export at over 1,000,000 tons of commercial rice valued at not less than sixty million pesos, we are brought face to face with the terrifying figure of six to ten million pesos direct loss per year from these rodents. The rats belong to three distinct subspecies, no one of which seems to be found in the Philippines—although the Philippine rats now number over forty distinct varieties and species. In Cochin China poisons have not been very successful but in the Philippines a fair amount of success has usually resulted from the use of arsenical baits. The loss from rats in the Philippines is very severe but probably nothing like the 25 per cent or more of our neighboring country.

CHICK PEAS.

The East Indian gram, or chick pea, is gaining great favor in certain sections of Europe as a stock feed. It can be imported for about the same price as American maize and is said to be a little better feed. In Denmark, for instance, the importation seems to be above 40,000 tons per year. The Mexican tableland produces this crop to perfection and in certain districts of India it succeeds very well except during the rainy season; in the Philippines, however, it is practically impossible to grow it. The comparatively few tons imported into the Archipelago are consumed very largely by the Spanish residents. Properly cooked, there is, perhaps, no better leguminous grain for the table than the "garbanzo."

DRIED MANGOS.

The bureau of agriculture of the Mexican department of fomento is succeeding with mango-drying tests which are being made at the agricultural experiment station at Tapanatepec, in the State of Oaxaca. The nearly ripe mangos are cut into slices, dried in the sun, and the product is then packed in small wooden boxes holding one or two kilos; the layers are kept apart with mango leaves. It is said that the fruit keeps a long time and that the demand is increasing.

COCONUTS IN BRITISH GUIANA.

The department of science and agriculture of British Guiana is endeavoring to put the coconut business of that country on a firm and very modern basis. The April number of the Journal of the Board of Agriculture of British Guiana contains a very interesting article on the cultivation of coconuts, most of

the ideas brought forward being absolutely in harmony with those of our Bulletin 17 and the Coconut Number (May, 1912) of the AGRICULTURAL REVIEW. Though artificial driers are thus far not much in evidence, considerable attention is given that subject. In British Guiana it seems there are even more insect pests of the coconut than we have in the Philippines, and furthermore the budrot is a constant menace to planters there.

Messrs. J. B. Harrison and F. A. Stockdale are the authors of this article; Mr. Stockdale has had a wide experience in tropical American coconut culture and the fact that he does not disagree with any of the ideas put forward by this Bureau in that line is worthy of note for, although South American conditions differ in many respects from those of the Philippines, the culture of the coconut is held to be practically the same in all countries.

BEEF INDUSTRY IN SOUTH AMERICA.

In the so-called River Plate district of South America, i. e., in the countries of Uruguay, Paraguay, Argentine, and Brazil, no less than 1,317,100 head of neat cattle were slaughtered in 1911 for "tasajo," or jerked beef. To this number may be added 356,100 head slaughtered for meat extracts and preserved meats. The increase in the number of modern packing houses predicates the disappearance of the old-fashioned "saladeros," or jerked-beef plants; it is a question whether this change in the enormous beef industry of that part of the world will soon affect the price of canned meats in the European and Oriental markets.

By the way, a 77 page bulletin on the canning of foods has recently been issued by the United States Bureau of Chemistry's laboratory at San Francisco, California.

The present number of cattle in Argentina is above 28,000,000 head.

DRIED FRUITS IN CALIFORNIA.

In 1911 the output of dried fruits in California, according to the California Fruit Grower, was over 197,000 tons; the bulk of this figure is represented by prunes, 95,000, and raisins, 65,000 tons.

IS THE ARAB HORSE PASSING?

In Cairo, Egypt, there is now being instituted an international society for the preservation of the pure Arab type. This breed has been used to such a remarkable extent for crossing with other breeds, not only in Europe but even in India and

various countries of northern and north central Africa, that it is said to be now a rather difficult matter to find an absolutely "pure-blooded" Arab outside of limited areas like the Arabian and Syrian deserts where the Bedouin tribes are jealously guarding a comparatively small number of these valuable animals. In Asiatic Turkey, Algeria, and the Sudan, it appears that there has been a considerable infusion of various alien breeds, so that, although the horses are popularly known as pure-bred Arabs, the hippologists could find some fault with this statement.

From the Agricultural Journal of the Union of South Africa we learn that that government recently sent an expedition into Northern Nigeria and thence across the border into the French Sudan in a search for new breeds of ostriches, and incidentally two fine stallions of the rare Asben breed were brought back. This expedition traveled up the Niger River for six days, then by train to Kano near the Sudan boundary of Northern Nigeria; from that point the expedition started overland with ninety-four carriers into the Sudan wilderness. Some 800 kilometers north of Kano the party came upon the strange race of Tuaregs, who are said to have descended from the Saracens who fought in the Crusades during the time of Richard Cœur de Lion. The Asben tribe of these people inhabits the hilly district of Air, a sort of island in the vast Sahara Desert, isolated by 400 kilometers of sand wastes stretching in every direction; they are very carefully striving to maintain their breed of horses absolutely free from other breeds and they claim that the Asben horse is far superior to the ordinary Arab, even declaring that the former animal can cover as much ground in one day as the Arab will in four! It seems that the Asben, or Air, breed is found in two varieties, the black and the white; a specimen of each type has been brought back to South Africa where it is hoped great benefit will result to the horse breeders of that part of the continent. It is stated that the Tuaregs, or Taureks, are most treacherous and bloodthirsty and the expedition frequently had to run very grave risks, to say nothing of the hardships and privations in obtaining these stallions.

In passing it may be well to note that the Arab blood is now recognized as an important element in the following breeds of Europe: Boulonnais and Percheron of France; Orloff, Strelets, Cossack, and Rastopchine of Russia; several types of Hungarian horses; the Anglo-French-Arab cross-breeds; and, of course, the English thoroughbred.

No one can say what another half century of thrematology will bring forth in the horse line, but up to date the Arab breeds are assuredly the most perfect and most aristocratic horses the world has been blessed with. Why? Because, as the Arabs, who almost worship them, say, "Allah *made* them so!"

SOME UNUSUAL ANIMAL PRODUCTS.

Although Florida, California and recently Australia, are beginning to realize that there are big profits in ostrich raising, the real center of the business always has been—and probably will continue for a long time to be—Cape Colony. Here ostriches are bred as carefully as horses and the best and most successful "feather growers" are as proud of their pedigreed studs as the average American or European animal breeder. When it is possible to raise birds worth ₱1,000 to ₱2,000 per pair on alfalfa, which costs practically nothing, and to pluck from such birds feathers which actually do sell for from ₱1,000 to ₱1,500 per kilo, the wonder is that so few men are in the business.

China consumes about one million pesos' worth of trepang per year. The Philippines export, mostly to China, about one-tenth of this quantity. Under proper management and with first-class agencies in the Chinese ports, this business could undoubtedly be trebled within two years. Several distinct varieties of these "sea cucumbers" occur abundantly about the southern islands of the Archipelago.

There seems to be no doubt that the world has a strong oil hunger, or shall we say, thirst. Notwithstanding the tremendous increase in Europe's copra imports—now about 2,000 tons per day—besides the 200,000 tons or so per year of peanuts from Africa and India and a similar quantity of oil-palm nuts, the price of whale oil is still so high that that industry throughout the world is "booming." For instance, in the Falkland Archipelago in the South Atlantic it is reported that at least 8,000 whales were taken last season, and this number is probably short of the true figure since there are a number of tramp whaling steamers which have no fixed base and which are satisfied with one whale per week; other large plants are located in the Crozets between Africa and Australia. The new factories at South Georgia, the Falkland Islands, and the South Sandwich group are running with a full equipment of fifty swift and powerful whalers and over 1,000 men during the season. This business extends up the west coast of South America and recently Brazil has become interested, while the Pacific Coast

of America, the Arctic Region and Japan are all putting in modern improvements to be able to meet the renewed demands for oil, meat guano, and bonemeal,—for not only the oil but also the bones and dried and ground meat, or "whale guano," are profitable products of the catch.

A warning note has been sounded, however, on account of the threatened extinctions of these valuable mammals by the too rapid rate of slaughter. Southeast Africa is beginning to realize that it will take only a comparatively few years more to practically exterminate the humpback whales on the east coast of that continent. The writer has seen several schools of twenty to fifty individuals each in the course of a day's sail off Mozambique, but when it is remembered that two or three whales (about one-third "cows") are caught every day at the whaling stations in that region, and when we consider that the humpback whale (*Megaptera longimana*) probably does not reach maturity before the age of fifteen years (the right whale requires twenty or more), we can easily "see the finish" of the industry.

It is possible that the largest whale ever recorded was recently reported as captured by the Corral Whaling Company, of Chile. It is said this mammal "measured 125 feet and yielded 100 barrels of oil;" about 28 to 30 meters (90 to 100 feet) is considered the maximum length of the North Atlantic whales. It is difficult to imagine the size of such an animal, but calculating the weight of the ordinary 10-meter humpback at 15 to 20 tons, a whale nearly three times the length of that species would weigh probably ten times as much.

By the way, this makes this South Pacific (presumably "sulphur bottom") whale the largest mammal the world has ever seen even in the geological epochs; even the old atlantosaurus reached only about the same length as this whale, and with its exceedingly slender neck and long tail, the body itself was probably only a few times the size of an elephant—which of course is not to be compared at all with the body of a 38-meter whale.

ANOTHER SHARK-INDUSTRY IMPETUS.

With the shark-fin industry of the Sulu Archipelago in mind, the following note by Vice Consul-General D. Milton Figart, of Singapore, which appeared some months ago in the Daily Consular and Trade Reports will be of interest:

> It has been proposed to start in Malaysia a small export trade in shark's-liver oil. This oil is refined in Europe and sold as cod-liver oil. In October the ocean sharks come into the lagoon, between the barrier

reef and the atolls, to pair. At this time they can be speared in large numbers by people skilled in catching them. There are several species of these sharks and they ordinarily run from 7 to 15 feet in length. The girth of an ordinary shark is the same as its length, and an 11-foot shark would be 11 feet around the body. The liver of a shark of this size gives about 5 gallons of oil. The oil brings $73 a ton. The sharks are found in pairs and the harpooners try to kill the male first, in which case they are able to also spear the female, as it does not desert its mate.

If a 3-meter shark, single and unattended, will yield 20 liters of high-grade oil from the liver alone, to say nothing of several pesos worth of fish guano, it should not be long before something is done to take advantage of the tremendous number of sharks around our southern islands.

ROACH-PROOF BOOK VARNISH.

Of the several so-called varnishes for protecting books, leather, etc., from damage by insects in the Tropics, the following formula is highly recommended, the author having successfully used it against roaches in one of the worst countries from that point of view in the world—Porto Rico.

Wood alcohol or strong vino	1 liter.
Carbolic acid, full strength	30 grams (1 oz.)
Corrosive sublimate	15 grams (½ oz.)

This mixture should be allowed to stand, after shaking, for twenty-four hours before using; it should be kept in a large bottle with a conspicuous "Poison" label, beyond the reach of servants and children. It should be applied with a bit of cotton tied to a stick or with a small paint brush. It should not be applied to soft leather nor to bright colored bindings. One application every six months is sufficient.

PRINCIPAL PHILIPPINE IMPORTS AND EXPORTS—OCTOBER, 1912.

By the INSULAR COLLECTOR OF CUSTOMS.

[Values in dollars United States currency.]

IMPORTS.

Articles.		Manila.	Cebu.	Iloilo.	Total.
Rice	Kilos	7,350,841	3,171,657	1,097,457	11,619,955
	Value	366,646	139,885	42,541	549,072
Beef cattle	Numbers	520			520
	Value	15,862			15,862
Eggs	Dozens	320,179	186	207	320,572
	Value	26,826	15	29	26,870
Sugar	Kilos	255,206	53,330	20,484	329,020
	Value	20,678	4,540	1,606	26,824
Coffe	Kilos	76,136	1,727	2,169	80,032
	Value	24,771	550	750	26,071
Cocoa	Kilos	22,718	5,513		28,231
	Value	7,892	1,689		9,581
Raw cotton	Kilos				
	Value				

EXPORTS.

Hemp	Kilos	13,638,798	2,287,987		15,926,785
	Value	1,934,350	290,836		2,225,186
Copra	Kilos	14,679,696	2,623,983		17,303,679
	Value	1,535,398	260,070		1,795,468
Sugar	Kilos	6,385,526		30,208,152	36,593,678
	Value	292,403		1,386,693	1,679,096
Cigars	Thousand	14,978			14,978
	Value	239,430			239,430
Cigarettes	Thousand	4,673			4,673
	Value	5,963			5,963
Tobacco	Kilos	1,348,460			1,348,460
	Value	192,928			192,928



Photo by C. M. Conner.

Six varieties of Hawaiian cane, first ratoon crop, eleven months old, showing arrows. Alabang stock farm, Alabang, Rizal.

THE PHILIPPINE

Agricultural Review

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CONTENTS.

	Page.
Editorial	55
Bureau of Agriculture Circular No. 18, Rice Culture	57
The Work of the Division of Agronomy, by C. M. Conner, Chief, Division of Agronomy	64
Power Plowing in the Philippine Islands, by Z. K. Miller, Chief, Division of Machinery and Construction	66
A short Review of the Sugar Industry in the Philippine Islands, by C. M. Conner	74
The Production of Grass and Hay, by C. M. Conner	81
Data Concerning Varieties of Rice, by C. M. Conner	86
The "Rag-doll" Test for Seed Corn, by H. O. Jacobson, Agricultural Inspector	93
A New Variety of Maize, by C. M. Conner	96
Salt Water Rice, by C. M. Conner	97
Current Notes—February: Terminology for Philippine Fiber Products; Propagating Abacá (Manila Hemp) from Seed; First Crop of Maguey (Cantala) and Sisal; The Valencia Orange Trade; Avocado Commerce; East African Coconuts; Chinese Narcissus; Rare Formosan Trees; Goats; A New Earth Nut; The World's Present Sugar Crop; Garbanzo or "Chick Pea;" A New Coconut Pest; Kerosene Emulsion and Loctones; Injury to Rice erroneously attributed to Insects	98
Principal Philippine Imports and Exports—November, 1912	108
Temperature and Rainfall for Agricultural Districts in the Philippines—November	109

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ILLUSTRATIONS.

PLATE I. Hawaiian varieties of Sugar Cane, Alabang Stock Farm ..... *Frontispiece*

Facing page—

II. Twenty-five varieties of Lowland Rice 68
III. (*a*) Kerosene tractor and gang plow; (*b*) "V" Shaped disk gang plow 68
IV. (*a*) Heavy six-disk plow; (*b*) Broken disks and castings 68
V. (*a*) Six-disk plow designed for any class of soil in the dry season; (*b*) Steam cable engine and balance plow 68
VI. Sugar cane in arrow 84
VII. (*a*) Transplanting land to zacate; (*b*) Cutting zacate for market 84
VIII. "Rag-doll' test of seed corn 84
IX. A new variety of corn 84

TEXT FIGURES.

Page.

FIG. 1. Rice rainfall chart 58
2. Rice-production map 61
3. Philippine varieties of rice compared with Indo-Chinese varieties 87
4. Upland and lowland rice—comparative size of grains 89
5. Upland and lowland rice—comparative size of grains 90
6. Frequency of varieties of rice arranged in order of yield 92

EDITORIAL.

THE ANNUAL REPORT NUMBER OF THE PHILIPPINE AGRICULTURAL REVIEW.

In previous years it has been the custom to publish the Annual Report of the Bureau of Agriculture in the January number of the REVIEW following the end of the fiscal year covered by the report. This delayed the appearance of the report for a considerable period, and in 1912 a new policy was inaugurated, that of printing the report as a special number in addition to the twelve regular issues. Furthermore it was decided to have this report appear in English alone, and forward a copy to all subscribers, whether to the English or to the Spanish edition.

Some confusion has arisen on account of the above change, and this office is in receipt of a number of letters from subscribers to the Spanish REVIEW, asking that a Spanish copy of the report be sent to them instead of the English.

The above brief statement is made in order that the subscribers to the Spanish REVIEW may understand that the only copy of the report printed has been forwarded to them.

THE AGRICULTURAL OUTLOOK FOR 1913.

Agriculture never had a brighter outlook in the Far East than it has in the Philippine Islands at the present time. It is true that the effects of the drought of last year are still felt but the present rice crop is far in excess of any grown for a number of years and the cane crop promises well. The farmers are "getting on their feet," as it were. Larger machinery is being used and farming is being carried on under more scientific methods and on a greater scale than ever before.

With the present cane crop at least one large central and perhaps three small ones will begin grinding, something unheard of before in these Islands. Other large mills will begin operations in the near future.

One healthy sign that almost always indicates prosperity is the fact that land is advancing in value and the price of a day's work has almost doubled in the past three or four years.

The people have shown more interest in the cultivation of corn in the last two years than ever before.

The Bureau of Agriculture is trying to keep abreast of this advancement by supplying the farmers with better varieties of rice, corn and sugar cane, and teaching them better methods of handling these crops by operating demonstration farms and sending out lecturers.

BUREAU OF AGRICULTURE CIRCULAR NO. 18—RICE CULTURE.

[Circular No. 18. Manila, September 21, 1912.]

RICE CULTURE.

By Chas. M. Conner, *Chief, Division of Agronomy.*

The cultivation of rice has occupied the attention of the inhabitants of the Philippines for a longer time than any other one crop, and is to-day one of the most important crops because it furnishes nourishment to practically all the people, and is cultivated almost universally. The area under cultivation during 1911 was 1,043,757 hectares, which was nearly equal to the total combined area cultivated in abacá (Manila hemp), corn, coconuts, sugar, and tobacco. The hectarage decreased slightly during 1911 but the average production per hectare was slightly increased, being 19.67 cavans [1] per hectare, as compared with 15.05 cavans for 1909. Some idea may be had of the production by provinces by examining the statistical map appearing in this circular.

The soils of the Philippines seem to be well suited to the growing of rice. Practically any soil in the Islands will grow rice if the necessary water is supplied and held on the plants. Since the retention of water seems to be one of the most essential characteristics, the mechanical nature of the soil should be taken into consideration in selecting a rice field. A fairly fertile soil containing about 50 per cent of clay is best.

The rice plant is aquatic and requires more or less water about its roots at all times for its best development. The rainfall is depended upon to supply most of this water; only about 50,587 hectares are reported as under irrigation. As a rule the rice-growing provinces may be divided into two groups, those that have pronounced wet and dry seasons and those having the rainfall distributed through the year. In the first group may

[1] One cavan equals 75 liters.

be placed the provinces of Bataan, Bulacan, Cavite, Iloilo, Laguna, Nueva Ecija, Pampanga, Pangasinan, Rizal, Tarlac, and La Union. Practically all the other rice-producing provinces fall in the second group. The average rainfall for each group is shown by months in the following chart.

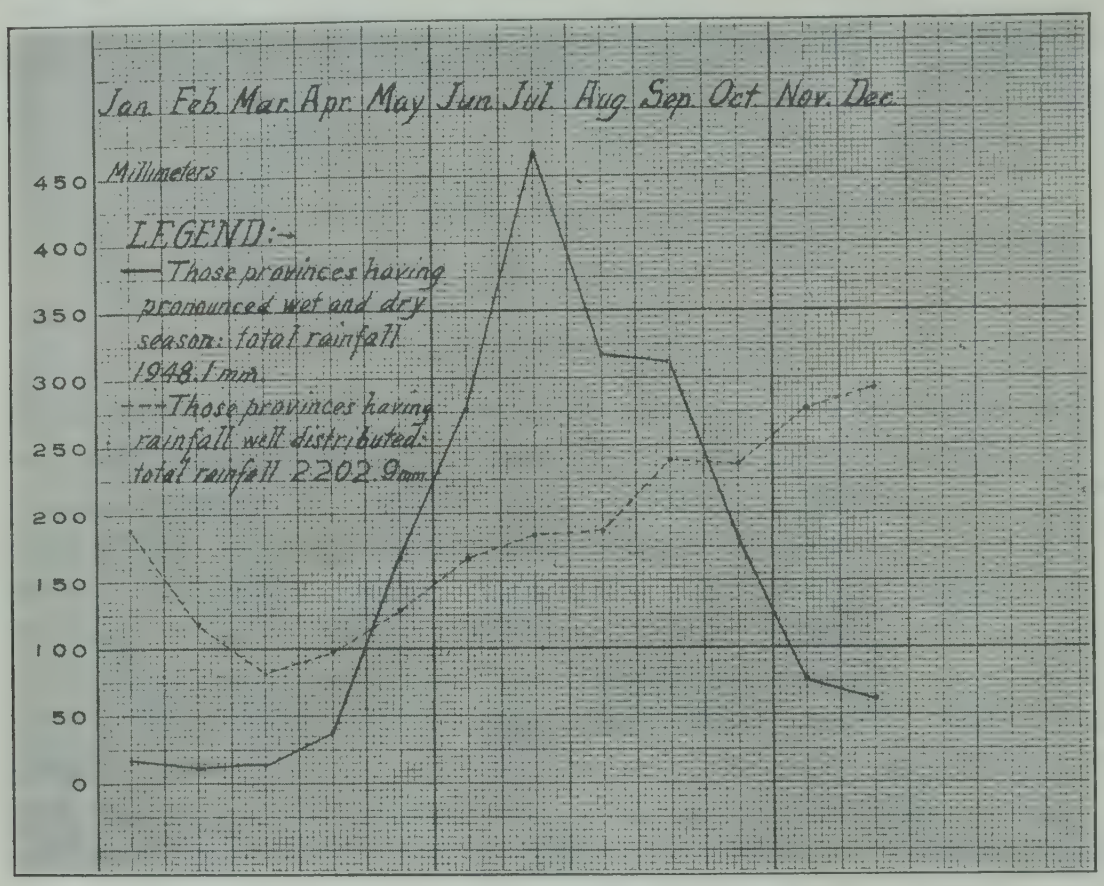


Fig. 1. Rice rainfall chart.

While this chart shows that the rainy season may extend from the first of May to the last of October, the real rainy season usually extends from the middle of June to the last of September.

The average variety of rice requires from one hundred and forty to one hundred and fifty days to mature.

The uncertainty of the time of beginning of the rainy season and the great quantity of water which may fall during a short period of time constitute practically the only drawbacks to the introduction of rice culture by machinery as followed in the United States.

It has been demonstrated that rice reaches its most perfect development, if grown during the rainy season, when the atmosphere is nearly saturated and the temperature is low. The crop grown during the hot dry weather does not yield as much as the former by 25 to 50 per cent.

Whatever method of planting and harvesting is followed, irrigation is almost essential to the best development of the crop. Irrigation water is necessary if two crops are to be grown and will be found valuable if only one crop is produced, as it frequently happens that the rains do not come in time to start the crop off properly and also there are dry periods in the so-called rainy season when a small amount of irrigation water would mean a 50 per cent increase in yield.

It is estimated that it takes 100 to 116 hectare-centimeters of water, well distributed throughout the growing season (say eighty days), to produce a crop of rice. On an average there are about 155 centimeters of rainfall between June 1 and October 30. If it is well distributed this is abundant, but if not, irrigation water must be used to supplement the rainfall.

In case irrigation water taken from streams by gravity is not available it may be supplied from shallow wells or rivers at a cost not to exceed ₱22 per hectare by using a direct-connected centrifugal pump and kerosene engine. An area of at least 50 hectares should be covered to bring the cost down to normal.

One of the first things that the rice farmer should give his attention to is the selection of a suitable variety and he should then keep it pure by careful hand selection. A variety having a clear hard grain, slightly over twice as long as broad, and of uniform size should be chosen. If the rice is grown for commercial purposes a white variety should be selected. A variety should be kept pure so that the grains will all be of the same size and in milling cause little loss from broken grains or grinding down of the large grains on account of the fact that the mill is set for the average-sized grain. A pure strain may be easily started by selecting each head separately the first year and taking care to plant in a clean seedbed and to thresh separately.

A medium early variety should be selected as there appears to be no difference in the yield of varieties requiring one hundred and forty as compared to those requiring one hundred and eighty to two hundred days to mature. Of the two, the variety requiring one hundred and forty days should be preferred because there would be nothing gained by exposing the crop to the ravages of insects and other pests as well as the danger of damage by storm. Again, if two crops are to be grown, a variety requiring longer time could not be used

A variety that is known to yield well should be selected, because it has been shown by variety tests conducted by this Bureau that 12 per cent of the marketable varieties produced less than 1,000 kilos of palay per hectare, 37 per cent produced between 1,000 and 2,000 kilos per hectare, and 51 per cent produced more than this amount.

There is practically no difference in the food value of different varieties. Clear white rice has practically the same food value as red rice. Some varieties have a pronounced flavor, which makes them more popular than others. This flavor is most noticeable just after harvest and is most common among upland varieties.

Nonbearded varieties should be grown in preference to bearded varieties as they cost less to harvest and thresh and give just as heavy a yield, other things being equal.

Varieties having a colored cuticle such as red or black should never be used except for special purposes. Such varieties, when mixed with white varieties, caused them to be classed as "mixed," and as such bring less on the market than unmixed.

Upland varieties may be changed into lowland and lowland may be changed into upland by selection.

Fourth-fifths of the rice grown is transplanted. It requires about 43 kilos, or one cavan, of seed to prepare a seedbed for transplanting 1 hectare.

In planting the seedbed, care should be taken to prepare the land well. Use some well rotted manure, if available. Sow the seed so that the plants will be thirty-five or forty days old (for medium early varieties) at transplanting time. If it is desired to gain time on account of the rains coming late, the seedbed may be prepared in the usual way, and banana leaves spread over the surface of the mud and sunk just enough to cover the seed which should be soaked for forty-eight hours before spreading over the leaves. The leaves prevent the roots from taking hold of the mud and allow the young plants to be separated easily. Plants may be taken from the seedbed by simply rolling up the banana leaves. Plants grown in this way may be transplanted at fifteen to eighteen days old.

Thorough preparation of the field before transplanting will pay well for labor expended. Plow twice if possible and harrow thoroughly.

When transplanted, the distance between the plants should be governed more or less by the variety. Those that have a tendency to throw out many shoots may be given more space; medium

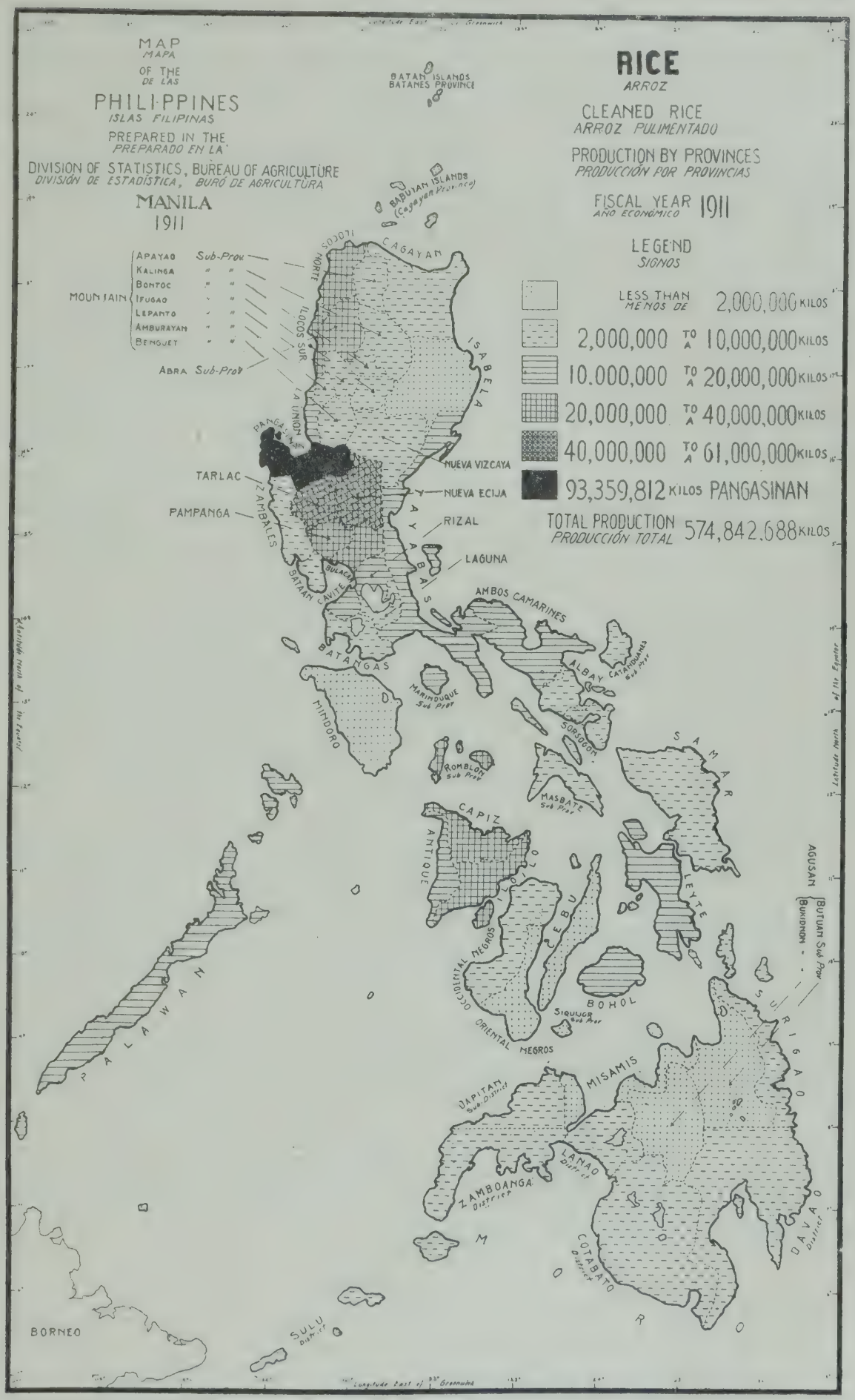


Fig. 2. Rice-production map.

early varieties should be given from 15 to 20 centimeters each way, with three and four plants in a hill. If the young plants are 20 or 30 centimeters high at transplanting time, about one-third of the top should be cut off as there will be less danger of their being blown over by high winds and they will take root sooner. After the young plants have established themselves the water should be turned on and kept moving, as stagnant water is harmful to the plants.

Frequently the second crop, i. e., the crop grown during the dry season, is sown broadcast. If there is sufficient labor to transplant, it is not advisable to follow this system, except in rare cases, as much better yields may be expected from transplanting. It is estimated that only about one-half the yield may be expected from broadcasting as compared with transplanting.

It is possible to grow two crops of rice and one crop of corn in one year by the aid of irrigation water. The corn should be grown during the driest part of the year, as the plowing of the soil in cultivating the corn will allow the air to enter the soil and cause the bacteria to break down the organic matter and otherwise improve it for the next crop. Whenever possible, mungos or cowpeas should be grown in the corn and when the ground is not occupied by growing rice, in order to keep up the supply of nitrogen in the soil. If the straw were left on the land and plowed under instead of being burnt off, it would also add much to the betterment of the soil.

The Bureau of Agriculture has collected and tested 910 varieties of rice native to these Islands. These may be divided into two great classes, upland and lowland. These may again be divided into glutinous and nonglutinous. Of the varieties tested, 452 were lowland and 458 upland. Some were found to do fairly well under both conditions.

The clear white, nonglutinous type is the one known to commerce. The glutinous varieties are used in making "dulces" and for distilling purposes.

The following lowland, white nonbearded, nonglutinous varieties, gave a yield of more than 2,000 kilos, or 46.5 cavans, per hectare as an average of three or more tests and may be recommended for general planting:

No.	Name.	Yield of rough rice palay per hectare.	Province where obtained.	Days to mature.	Average number of grains per head.	Size of grain millimeters.
246	Caoñgedy	2652	Cebu	137	212	5.5×3.0
827	Sipot	2412	Laguna	138	155	6.7×2.5
187	Cainti II	2402	Bohol	138	187	6.5×2.6
635	Mulan-ay	2551	Antique	141	212	6.0×3.0
530	Macan Piña	2659	Tarlac	143	243	6.5×2.6
61	Bengala	2440	Capiz	143	213	6.1×2.6
813	Señora	2571	Laguna	145	191	6.7×2.6
663	Pauni	2310	Tarlac	145	145	6.8×2.3
117	Bugaten	2875	Cebu	149	256	5.5×2.7
868	Tinabas	2373		149	187	7.0×2.5
710	Postoguer	2640		153	181	8.7×3.5
781	Saigon IV	2511	Antique	156	182	7.0×2.1
692	Piniling Daniel	2448	Tarlac	167	221	6.2×2.2
429	Inachupal	2408	Tarlac	168	241	5.9×2.4
447	Inasimang	2515	Tarlac	170	281	5.9×2.7
583	Mancasar	2378	Moro	174	227	6.3×2.5
88	Binatad	2407	Nueva Ecija	175	184	6.1×2.6
527	Macan	2288	Tarlac	178	200	6.1×2.5
27	Bad-as	2371	Occidental Negros	180	152	5.0×2.6
579	Manabun-ac	2831	Antique	183	163	5.6×2.7
598	Manticanon	2561	Tarlac	185	233	6.2×2.7
739	Quinanay	2435		185	187	7.0×2.4
225	Calobang	2623		186	323	6.2×2.4
473	Joquianan	2369	Iloilo	189	273	5.6×2.8
756	Quinatia	2338		189	205	5.2×2.8

If any of the above-mentioned varieties are to be found in the reader's district, it would be well for him to secure a small quantity of seed of each and make a comparative test. At harvest time select by examining each individual head to make sure of color and conformity to type. Carefully preserve these heads until planting time. If irrigation water is available they may be planted as the second crop and the quantity of seed largely increased by the time the next wet season comes around. If the selected seed is kept pure there should be enough seed available to plant the entire crop at the beginning of the next wet season. Selection should be continued in this way each season for three or four seasons, choosing each time the best heads and from plants that are prolific. Even if only ordinary care is exercised in making selections, it should result in a variety that would give a larger yield and a palay of uniform size and quality.

THE WORK OF THE DIVISION OF AGRONOMY.

By C. M. Conner, *Chief, Division of Agronomy.*

The work of the division of agronomy is confined at present to investigations relative to rice, sugar cane, corn, grass and hay crops, and cover crops.

With rice, efforts are being made to eliminate as much as possible the undesirable kinds and encourage the planting of better varieties. The substitution of a few good productive sorts for the nine hundred and ten varieties now grown throughout the Philippines would mean a gain in millions of pesos to the people of these Islands in increased yield and better quality at no extra outlay of labor or money. It is true that it will be some years before some at least can be persuaded that they should give up their old choice varieties for any new introduction. This has been the experience in other countries and it will be the same here.

Enough work has ben done already to show that 75 per cent of the kinds grown are useless. Something like nine hundred and ten varieties have been tested during the past years but only two hundred remain in the test this season and at least one hundred of these will be dropped at the next planting. All small varieties and those having a colored cuticle have been discarded as they are undesirable as a commercial crop.

Practically all glutinous varieties have also been discarded as their use is restricted and they are not known in the large rice markets.

The elimination of undesirable varieties will be about finished in one more year. The work of building up desirable varieties by selecting the best heads and propagating from these has been started and as fast as desirable varieties can be established, seed will be distributed to the people.

Tests are being made to determine distance to plant, or rather the number of plants to put on one hectare, in order to get the best yield.

Fertilizer tests are being carried on to determine just what fertilizers are profitable to use on rice. All of these tests are being made in different sections so that results, when obtained, will not apply to one locality only.

Work with sugar cane is confined, for the present, to introducing and testing new varieties, ascertaining distance of planting, and fertilizer tests. This work is being carried on at two different points by this division, and by coöperations in various parts of the Islands.

With maize, fertilizer tests and seed selection require most attention. Experiments are being made as to number of crops that can be grown per year profitably. Such matters as distance of planting, number of plants per hill and other like problems are being worked out slowly.

Owing to a desire on the part of the officials of the United States Army to secure data relative to hay production in the Philippine Islands, several grasses have been introduced with the idea of finding one that would be suitable for hay making. Only one, so far, has given any promise and that is being tested out on a rather large scale to see if hay can be produced profitably. During the past year this work has been carried on at two of the Bureau farms and also at San Miguel, Tarlac.

Cover crops are being tried out at the various farms of the Bureau. The object of making these tests is to find a crop that will be suitable for planting, after the rice and corn, to improve the soil. There are many leguminous crops that would be fitted for this purpose if it were not for the fact that they are subject to destruction by insects and plant diseases. If the fertility of the soil is to be maintained, it is necessary to have some such crops as cowpeas, velvet beans or mungos grown on the land after a grain crop such as rice, corn or sugar cane.

POWER PLOWING IN THE PHILIPPINES.

By Z. K. Miller,
Chief, Division of Machinery and Construction.

The plowing machinery introduced prior to the occupation of the Islands by the Americans in 1898 consisted, so far as known, of one set of cable plows and two or three steam traction engines, all of European make. The cable set was taken to the Island of Negros and tried out, with results so unsatisfactory that no further attempts were made in engine plowing until 1905. It was reported that the land had been plowed to a depth of 30 or 40 centimeters, bringing to the surface a subsoil that contained only a small percentage of plant food. This produced a short crop, and the owners thought the land was ruined. The plows used here were yet in the experimental stage, and were soon broken up and cast aside.

One traction engine was reported as having been tried out in Laguna Province with poor results, principally on account of the narrow traction wheels and generally cumbersome construction; the plow also proved worthless. However, the need of something better than the carabao plow was apparent to the planters in cane-growing districts even at that date, when carabao were both cheap and plentiful. During and following the period of political unrest, the rebellion and insurrection of 1896 to 1902, the majority of work animals disappeared, were killed for food, or died from animal diseases. The fields had been neglected, had become covered with sod, and overgrown with trees. As the farmer again took up the task of cultivating his land with the higher-priced work animals that were not immune to disease, the slow process of bringing the neglected fields into cultivation once more brought up the question of mechanical plowing. This matter was further stimulated by the reports from Hawaii, the United States, and various other countries, of the success that had been attained in those places.

In the central and western part of the United States where the land is almost level, traction engines have come into almost

universal use for plowing and preparing the land, and in many places for planting and harvesting the crops. The soil there is generally of a light sandy nature, friable, and easily worked after the sod has been broken up. At first this work was performed by ordinary steam threshing engines. The manufacturer quickly saw the need of larger machines and broader traction wheels with larger fuel and water tanks. The improvement of all kinds of traction engines, including steam, gasoline, and petroleum, has beeen remarkable in the last ten years.

During the year 1904 the Bureau of Agriculture imported an American-made plowing engine and a gang of plows. This equipment was considered the very best that could be obtained at that time. The engine was a double-cylinder, 35-horsepower, mounted on a locomotive-type boiler. The traction wheels were 80 centimeters wide and 2 meters high. The engine was equipped with two water tanks with a capacity of 300 gallons. Coal or wood was used as fuel. The total weight, when the tanks were full, was 14,000 kilos. The plow was of the share-and-moldboard type, each gang consisting of six 35-centimeter plows cutting a furrow 210 centimeters wide. (Plate III, a).

PLOWING EXPERIMENTS.

The outfit just described was taken to the Government rice farm at Murcia, Tarlac Province, and put to work on old rice land that had not been cultivated for nine years. The soil is sandy, with clay subsoil, and easily worked when moist. The land was irrigated, and the cross dikes leveled off previous to plowing; water was taken directly from the irrigation ditch into the engine tanks; wood was used as fuel. An average of 4 hectares, 12 centimeters deep, was plowed per day of ten hours. While the land was in a moist condition both the engine and plow worked well (except that the latter occasionally became clogged with trash) at an average cost of ₱6 per hectare, not including depreciation. After the land had dried out the plow failed to work as it could not be kept in the ground, the shares and axles wore out very rapidly on account of sand and dust, the rolling coulters were broken off and the plow beams were twisted out of shape, making the plow worthless. Some light disk plows were tried out with about the same results, with the advantage that they would not clog with trash. A test run of thirteen days of eleven hours each, with an ordinary 18-horsepower steam threshing engine, pulling two three-disk plows in moist land, cutting a furrow 152 centimeters wide, and using wood as fuel, gave an average of 4½ hectares per day at a cost

of ₱4.50 per hectare, not including depreciation. This test was made by an experienced operator on level land averaging about 1 kilometer in length.

Both the plowing and threshing engines gave very good results in moist land. When the land was dry the jolting caused the bolts to loosen, and the dust caused the gears and exposed working parts to wear out rapidly.

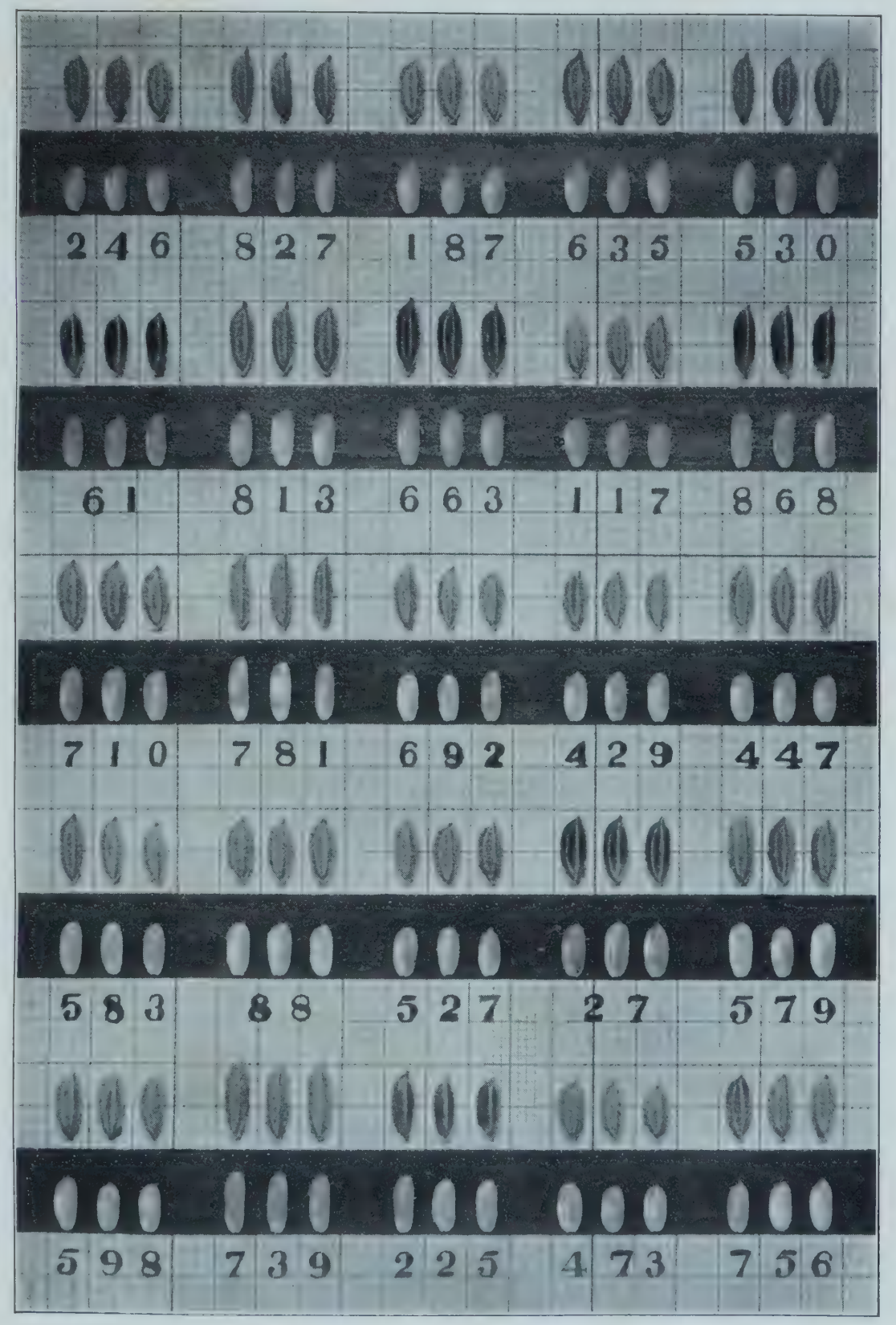
These two engines and equipment were taken to Laguna Province and were tried out on clay soils with the result that the plows were all broken up and rendered useless. More plows were procured (in all six different makes from the United States) and tried out, but all gave the same results. The trouble was that they were all too lightly constructed throughout to stand the hard work required of a plow in this country. During the rainy season the soil becomes packed and when the dry season comes on the land is moist for only a few days, as a rule, before it becomes so dry on the ridges that the plow will not penetrate.

The greater part of the land to be plowed had not been cultivated for twelve years or more, had become overgrown with cogon or talahib sod, and was covered with ant heaps, carabao wallows, trees, rice dikes, cane ridges, etc. On account of the rank growth of vegetation, which was difficult and expensive to clear off, the disk type of plow was selected for this work. These disks are fastened to the beams at an angle that permits them to roll through the land moving the earth to one side and turning it over, and covering up any trash or grass. The disks are set one back of the other in gangs at an angle that will cut all the land. The side pressure is overcome by setting the two furrow wheels on an angle. These keep the plow in position and regulate the depth. As the land becomes hard the side pressure increases until the wheels on the ordinary plow are forced out of the furrows and the plow travels off to one side. When additional weight is put on to keep the wheels in the furrow, the plow frame, axles, beams, and castings, twist out of shape or break.

DESIGNING NEW PLOWS.

The writer began for the Bureau of Agriculture a series of experiments in plow construction to make a plow that would give good results under these conditions.

A "V"-shaped plow (Plate III, *b*) was constructed having two rows of disks radiating from the point of the "V" forward



Twenty-five varieties of lowland rice.



(*a*) Kerosene tractor with a six-furrow share gang plow.



(*b*) V-shaped disk gang plow.



(*a*) Six-disk plow—one hundred per cent heavier than the ordinary plow.



(*b*) Broken disks and castings—effects of contact with stumps, ant heaps, and rice dikes.



(*a*) Heavy six-disk plow—designed to plow any class of soil in the dry season; gives excellent results.



(*b*) Steam cable engine with balance plow.

and at the same angle at the ordinary plow. The disks were placed opposite each other thus offsetting the side pressure as they cut through the land turning the soil outward. The frame was supported on three wheels, one at each point of the "V," two in front and one at the rear. A middle buster, attached to a gooseneck-shaped center beam, plowed out the strip left by the last two disks. The rear wheel was attached to this beam. The beam casting hangers and the castings that the disks were fastened to were made about 100 per cent heavier than for the ordinary plow. This plow would go into the ground when it was very hard and dry, and did excellent work. The principal objectionable feature, however, was that the land was left in ridges, making it quite expensive to level off.

A six-disk plow, built along ordinary lines but of much heavier construction throughout, was designed and made up. (Plate IV, *a*.) The wheels weighed 150 kilos each. The steel beams were 6 centimeters square, the axles 5 centimeters in diameter, and the frame in proportion, well braced. Much better results in plowing were obtained, but even this plow proved to be too light in heavy clay soils during the dry season; when plowing through old rice dikes and paddies, the beams and axles would spring, castings and disks break (Plate IV, *b*), and the wheels were forced out of the furrows, thus throwing the plow out of position.

Another plow (Plate V, *a*), with several improvements and of much heavier construction, was designed along lines similar to those of the one described above. The wheels weigh 280 kilos, and the axles and beams are 7.6 centimeters in diameter. The main frame and bracings are made in proportion. This plow has six disks that turn a total furrow 1.52 meters wide, and 10 to 25 centimeters deep according to the size of the disk used; any sized disk from 61 to 76 centimeters can be used without making any alterations. The total weight is 2,700 kilos. The engine to draw this must weigh 10,000 to 12,000 kilos and have a tractive force of 22 to 30 horsepower in sod breaking, or first plowing in old land, at any season of the year.

Several of these plows have been constructed and are doing satisfactory work. The disks are the weakest part of the plow. The question of making the disks heavier in the center, in order to stand the strain, has been taken up with the manufacturers who have agreed to make them any thickness desired. When this change has been made, this plow will work well in any class of soil during the driest season.

The best results can be obtained by having two plows, one of medium weight and the other heavy. (Plates IV, *a*, and V, *a*.) It will be found that in moist land and in replowing, the lighter plow will give good results and requires less power.

THE STEAM CABLE PLOW.

(Plate V, *b*.)

In recent years several sets of cable plows have been imported and are at work in different parts of the Islands. The larger sets consist of two steam traction engines, equipped with a drum located underneath the boiler. The engines are located on either side of the field, from 400 to 500 meters apart. The cable from one engine is attached to one end of the plow and the cable from the other engine to the other end. As the cable is wound up by one engine, the plow is drawn across the field while the other engine pays out the cable. This plow is made up of two gangs of right and left hand moldboard plows placed on either end of a heavy frame that is balanced in the center and supported on two large wheels. When the plow arrives at one side of the field, instead of reversing, the operator changes to the opposite end and as the engine on the opposite side of the field starts the plow on the return trip the axle is moved forward causing the forward part of the frame to rise out of the ground and the rear part to descend and commence plowing; only a small amount of time is lost in this way. There are several different kinds of implements to prepare and cultivate the fields which may also be drawn by cable. Parallel roads must be constructed at intervals throughout the fields for the engines to run on, and the fields must be cleared of any heavy growth of vegetation to prevent the plows from clogging. The advantages gained in using a cable plow are that rough or very moist land can be plowed where it would be impracticable to operate a traction plow; it is also possible to cultivate the land and to some extent dispense with the use of draft animals ordinarily employed in this work. The land can be plowed to a much greater depth which is desirable for certain crops.

The first cost of the cable plow, which is several times that of a traction outfit, will limit its use on the average plantation as the improved traction outfits will plow as much land as a cable plow and to a depth of 7 to 25 centimeters. With one engineer to operate, traction plows are coming into more general use, and even the largest sugar plantations recognize their value and are commencing to use them in connection with these cable plows.

TRACTION ENGINES.

Traction engines, like plows, need to be of heavier construction, especially in the frame and bracing, than the average engine used in the United States, in order to withstand the shocks incident to climbing over rice dikes, old cane rows overgrown with sod, through carabao wallows, etc. Unless the frame is well braced, it will soon get out of line, shear the bolts and break up. In 1908 the Bureau of Agriculture purchased a double cylinder 30-horsepower kerosene traction motor built expressly for plowing (Plate III, *a*). The main frame was made of 25-centimeter I beams. The cylinders, bearings and braces were bolted to these with heavy bolts. Traveling over the ordinary fields shook the engine up so much that the bolts sheared off. Clips were then placed over the castings and around the I beams clamping them on firmly; the result was that the I beams were cracked in several places.

The carbureters were also defective and complicated. In all, seven valves were used on the gasoline, kerosene and water-feed pipes. When starting the engine, gasoline was used until the cylinders commenced to warm up, then kerosene was turned on and gasoline off. After the cylinder got hot, water was turned on and the amount was gradually increased until the engine stopped pounding. If water was turned on too quickly the engine would be killed. Also when the full load was taken off the valves had to be readjusted, and often when again taking the full load the engine would die. The services of a skilled operator were necessary to keep the machine running.

A kerosene plowing tractor, recently imported, has been in operation for several months in Laguna Province with fairly good results. It promises to be something far superior to any traction motor previously imported. This is only a 15-horsepower machine but the main frame is as heavy as that of the 30-horsepower machine previously described, and wherever possible is riveted together; the cam shaft and automatic governor work in a dust-proof case. The carbureter is automatically controlled by the governor and if the load has been thrown off for an hour or longer no trouble is experienced and no readjustment is necessary when the load is again put on.

COST OF PLOWING.

The cost of plowing with traction engines in the United States and with carabaos in the Philippines is about the same, approximately ₱15 per hectare. The cost of traction plowing in the Philippines depends entirely on the class of soil, fuel, and

season, and varies from ₱3.40 to ₱18 per hectare. The lowest was under very favorable conditions; the highest occurred during a run of twenty-eight days in Laguna Province with a 35-horsepower engine; 64 hectares of land were plowed at the rate of 2.3 hectares per day, at a cost of ₱18 per hectare. Coal, at approximately ₱20 per ton, was used for fuel. The farmer furnished all labor except fireman and engineer and often the steam would be up and the outfit waiting for two or three hours before anyone would appear to man the pumps or bring fuel, and as a rule an ant heap would not be picked down until the engine was against it, and stumps were cut off even with the ground. This resulted in frequent breakage and stops, and increased the cost of plowing.

As a comparison, another planter in the same vicinity procured wood for fuel, cleared off the land in advance, and had the machine properly served. With an 18-horsepower engine, 40 hectares were plowed at the rate of 3 hectares per day at a cost of ₱3.40 per hectare, exclusive of depreciation. The land was prepared by leveling off ant heaps and digging out all tree stumps 25 centimeters below the surface of the ground, and wood was provided in advance, and only a few minutes were required to put on fuel and water at each stop.

The cost of plowing with a cable plow will vary from ₱10 to ₱15 per hectare, according to the condition and class of soil. By making careful preparation in advance, clearing off obstructions, taking out all stumps and roots to a depth of 30 centimeters, leveling off ant heaps and rice dikes, and selecting the best plowing machinery obtainable, there is no valid reason why mechanical plowing can not be made to pay dividends. Especially is this true where land is to be put into cultivation the first time for rice, and on sugar cane and coconut plantations. A conservative estimate of the cost of plowing sodland would be about ₱18 per hectare. This covers depreciation, cost of labor, fuel, repairs, etc., but does not include the cost of preparing the land before plowing. When the quality of the work and time required are taken into consideration, however, the power plow will win out over the carabao where the land is level and in large fields. Experienced men should be consulted before equipment is purchased in order to obtain the best for the class of work required. Care should be exercised and conditions carefully ascertained; for instance, if plenty of wood and water is available, the steam engine would be most economical; or, if fuel is to be brought a long distance, a kerosene motor

would be best. The question of plows is of even greater importance. Some points in operation should never be forgotten. The machinery should be well lubricated and kept in adjustment; sodland and rough places should be gone over slowly; the engine should be started gently and should not be jerked or overloaded; a sharp lookout should be kept for loose bolts; the machinery should be studied and cared for as one would a horse, to give good results.

One of the needs of the present day is a school that will furnish practical instruction and experience in the care and operation of traction machinery, giving young men a thorough course in this work. A certificate upon completing the course at such a school would insure employment in a better position, three times over, than the average clerkship would pay.

A SHORT REVIEW OF THE SUGAR INDUSTRY IN THE PHILIPPINE ISLANDS.

By C. M. Conner, *Chief, Division of Agronomy.*

ORIGIN.

It is not known just when sugar cane constituted one of the cultivated crops of the people living along the coast of South China or the Malay Peninsula, from whence it was undoubtedly introduced into the Philippine Islands. There is little doubt, however, but that it was first made use of in India, perhaps along the Ganges. As it is not now found in the wild state in any country it is impossible to even guess its original home. There are several grasses growing in the Philippine Islands and in tropical India that are closely related to the sugar cane, but variations in soil, temperature and rainfall cause such wonderful and comparatively rapid changes in all plants in the Tropics that it is impossible to say what a certain plant was like a few thousand years ago. The people who did first make use of it, perhaps found it growing wild in the jungle where it served as food for such animals as wild swine, elephants and other herbivorous animals. That swine fed upon it to a considerable extent would seem very plausible, and in rooting up the mature plants, the younger ones which escaped destruction were cultivated, as it were, and the field was left in good shape for another crop.

FIRST USE.

Undoubtedly the cane was first used in chewing the stalk for the juice. Even at this time one will find sugar cane peeled and cut in small blocks and served at meals in Siam and parts of India. The juice was also extracted by crude methods and used as a fermented drink. Some one finally discovered that by boiling the juice it would become sweeter and would not ferment so rapidly. Geerligs says that fellow-travelers of Alexander the Great mention in their notes a reed growing in India

which produced "honey" without bees. This "honey" was perhaps a thickened sirup made by boiling the juice until it made a thick sugary molasses, called "gur" in India. Such sirup has been used by the natives in India since prehistoric times and is known in Sanskrit as "gud," which indicates a very ancient origin.

In order to make sugar it was only necessary for some one to accidentally boil down some of the juice to the point at which it would crystalize. This occurred about the seventh century in India.

Sugar-cane culture had reached the shores of the Mediterranean early in the Christian Era, and the Egyptians were among the first to make a kind of pure sugar by re-crystalizing. This did not happen, however, until several hundred years after the discovery of sugar.

INTRODUCTION INTO THE PHILIPPINES.

The cultivation of sugar cane and the art of making sugar were undoubtedly introduced into the Philippine Islands by the Chinese. A description of the machinery and early methods used along the coast of China and Formosa reads very much like a description of early methods used in these Islands. Magellan, in 1521, found the sugar industry already established, although on a very small scale.

It is known that sugar making was first carried on in the Provinces of Pampanga and Batangas. The main reason why the industry flourished in these provinces only, in the early days, was that it was not safe to go into other sections with any large amount of property and as it requires a rather expensive equipment to grow and make sugar, the growers did not care to take the risk. However, as conditions improved, the industry began to spread to various other islands.

SUGAR SOILS.

In these Islands there is no "typical" sugar soil. Sugar cane is grown on every kind of soil from light sand to heavy clay, the essential conditions being sufficient natural fertility, good drainage, and a retentive subsoil.

Much of the sugar cane in Pampanga is grown on a light sandy soil of rather low natural fertility. In Laguna and Batangas, the sugar soils are composed of a black, heavy, very retentive clay, except in the neighborhood of Taal volcano, where more or less volcanic ash is mixed with the soil making it rather

light and easy to work as compared with the heavier soils near Lake Laguna. The majority of the soils are of rather high natural fertility. These black, sticky soils around Laguna grow very good cane. The Hawaiian varieties of cane grown at Alabang, Rizal, which is on Lake Laguna, seemed to make as vigorous a growth as did the same varieties at La Carlota, Occidental Negros; no fertilizers were used at either place. The sugar mill at Muntinlupa, mentioned elsewhere, makes sugar from cane grown on this type of soil.

In Occidental Negros most of the sugar soils are of volcanic origin and are of rather high natural fertility. Here and there are found many fertile spots which shade out to poor unproductive soils; there are large areas, however, which compare favorably with any of the sugar soils of the world. The average yield of sugar per hectare for the Province of Occidental Negros, as shown by statistics collected by the Bureau of Agriculture, is 2,295 kilos. This average is lowered by the great number of fields poorly managed and fields of low fertility planted to cane. Walker [1] says "I may state from personal observation that on a well managed plantation—and there are a few such in Negros—the yield per hectare under normal conditions of land actually planted in cane will rarely fall below 60 piculs (3.8 metric tons), and frequently comes nearer 70 piculs (4.4 metric tons); this should hold true in the poorer as well as the richer sections, as the difference in quality of soil is in a measure made up for by the fact that cane grown in the former is as a rule richer in sucrose and is replanted every year on fresh soil, whereas in the latter it is allowed to ratoon until the yield becomes greatly diminished."

COMMERCIAL FERTILIZERS.

Commercial fertilizers are not used to any extent on sugar cane as yet in these Islands, but as more large mills are established and more intelligent methods of culture are put into practice, commercial fertilizers will find their proper place in cane culture. In most of the older cane-growing sections some sort of rotation is followed. In Pampanga and Tarlac other crops such as rice and corn are planted on the land after the cane crop. In Negros it is the custom to allow the fields to lie idle for one year after the last ratoon crop is taken off and pasture the work stock on this land during the season. Both of these methods have their faults. While in the first they

[1] The Sugar Industry in the Island of Negros, page 81.

secure some returns from the lands, such returns are not as great as they would have been had the land been in cane; neither was the soil improved for the next crop of cane. In Negros, nothing is gained in the way of a crop except pasture for the work stock, but the land is slightly improved on account of the increase in humus or organic matter left in the soil by the crop of grass. It would be infinitely better if the fields were planted in cowpeas or velvet beans and the crop either harvested for hay or pastured off with cattle. In either case nitrogen should be added to the soil to produce two or three good crops of sugar cane.

In making use of commercial fertilizers, it will be necessary to make a study of the soil. Different haciendas may require fertilizers of different compositions and much experimenting will be necessary before a formula is decided upon for any one locality.

Fertilizers do not improve the quality of sugar, as many people believe, but on the contrary tend to produce a juice having more impurities than that from cane grown on poor soil. This fact, however, need not discourage the use of fertilizers as these impurities are easily removed by the modern mill. It should be borne in mind, however, that unless there is a uniform supply of water for the crop, either by rainfall or irrigation, much of the expected increase from the use of fertilizers will be lost.

VARIETIES.

New varieties of sugar cane are not easily produced, hence the number of varieties found in these Islands, prior to the organization of the Bureau of Agriculture, was very limited.

New varieties are produced in two ways, first by growing young seedlings, which by the way is very difficult, and by bud-sports from some established variety. Many new varieties have been tested out during the last twenty years but only a few have met the requirements of the planters.

Walker[1] says that "The native cane ordinarily grown in Negros is, in respect to the richness and purity of its juice, equal to that of almost any other sugar-producing country in the world, and, having in addition a comparatively low fiber content, could hardly be improved upon in its adaptability to a thorough and economical extraction by milling." Some new varieties introduced from Hawaii, in 1910, were grown at Alabang, Rizal Province, and La Carlota, Occidental Negros. A test

[1] The Sugar Industry in the Island of Negros, page 81.

was made of these by the Bureau of Science and the results are given below together with the variety mentioned by Walker (referred to above) which is shown in the last line, second section of the table.

Analysis of varieties of sugar cane.

Names of varieties.	Juice.	Polarization.	Brix.	Purity of coefficient.	Names of varieties.	Juice.	Polarization.	Brix.	Purity of coefficient.
	Per ct.	*Per ct.*				*Per ct.*	*Per ct.*		
H-16	75.8	14.3	16.3	87.8	H-227	78.3	14.1	15.9	88.8
H-20	90.3	18.3	19.3	94.9	H-309	93.2	14.9	17.1	87.6
H-27	77.3	17.0	17.9	95.0	Native cane	78.8	19.9	20.7	96.5
H-69	81.8	12.9	15.0	86.0	Negros cane	89.9	18.4	20.3	90.3

Hawaiian varieties of sugar cane grown at Alabang.
Harvested December 20, 1911.

The six Hawaiian varieties mentioned above were planted at Alabang in December, 1910. On December 10, 1911, another field was planted to these same varieties. On November 11, 1912, both these fields were in full arrow. There seems to be something in the climate which makes these varieties mature much earlier than they do in Hawaii. (See Plate I.)

The larger growing varieties, common to Hawaii and other cane-growing countries, have not met with popular favor among the small planters, first for the reason that the stalks were too big for small mills to handle and second because the larger varieties would not respond properly under the native methods of handling. The native cane is planted in rows varying from one-half meter to 1 meter apart, depending upon the locality. Cane so planted soon covers the ground and checks the growth of weeds and grass but does not produce the greatest amount of sugar per hectare. It is true that the smaller native varieties may be planted closer than the larger foreign varieties but the general tendency heretofore has been to plant too close. Some of the more progressive farmers in Laguna and Pampanga are planting the native cane in rows 1 meter to $1\frac{1}{4}$ meters apart; for the larger foreign varieties, the distance is increased 50 per cent.

On the San José Estate at Mangarin, Mindoro, where 5,000 hectares of new land are being planted to cane, the native varieties are planted in rows $1\frac{1}{4}$ to $1\frac{3}{4}$ meters apart and the tendency has been to increase rather than to decrease the distance.

It should be understood that these distances are possible only where the cane is given the best possible culture and attention.

The division of agronomy of the Bureau of Agriculture has the following varieties of sugar cane under observation:

Common Negros purple.
Inalmon, Negros dark purple.
Yellow Caledonia.
Rose bamboo.
Striped Louisiana.
Lahaina.
H-16.
H-20.
H-27.
H-227.
H-309.

A limited number of stalks of these, for seed purposes, may be had free of charge. Large quantities, when available, will be sold at the rate of ₱10 per ton, parties desiring the cane to pay cost of cutting and of transportation to shipping point.

EXTRACTION OF JUICE.

The juice of sugar cane was first extracted by pounding short pieces of cane in a mortar. A small outlet was left at the bottom and the juice allowed to run out into a jar.

The first mills consisted of two wooden rollers set in an upright position and turned by animal power. This was followed by stone rollers cut out of granite at a very great cost of time and patience. The steel rollers are of rather modern origin.

Naturally a large per cent of the actual sugar was lost on account of faulty methods of extracting the juice and only a low grade of sugar was made owing to the methods followed in boiling. These ancient methods, with only slight improvements, have continued down nearly to this date. A new era, however, is dawning for the sugar industry, as modern mills are being installed and sugar of the highest quality is being produced.

CENTRALS.

At the present time there is one large central in operation. This mill has 11 rollers and is capable of grinding 1,200 tons of cane in twenty-four hours. It is located at Mangarin, Mindoro, and is owned by the Mindoro Company. Two mills of like character will be ready to begin operations in the near future. One, owned by the Calamba Estate near Calamba, Laguna, will be ready to begin operations in 1914, and another,

at San Carlos, Occidental Negros, owned by the San Carlos Milling Company, will be ready to begin operations in 1915.

There are also in operation three smaller mills, with a capacity of 125 tons of cane in twenty-four hours, located in various parts of the Islands. One, owned by Macondray & Company, is at Muntinlupa, Rizal Province; another, owned by the Roxas Estate, is located near Nasugbu, Batangas, and the other, owned by S. Urquijo, is near La Carlota, Occidental Negros.

Several other small mills are in project.

As soon as these mills get well underway and the people see that there is more money in selling the cane to the large mills than there is in manufacturing a low grade of sugar, other mills will go up as fast as money can be found to finance them.

THE PRODUCTION OF GRASS AND HAY.

By C. M. Conner, *Chief, Division of Agronomy.*

The native horses used for riding and driving are fed almost entirely on green grass, known locally as zacate. A variety known as barit (*Leersia hexandra*) is grown almost exclusively for this purpose in and about the city of Manila. This brings the highest price of any zacate sold on the market, and is produced under very intensive methods of farming. In the provinces where the owners are not so exacting as to the kind of grass fed to their horses, many kinds of green stuff are used. One of the most common is known as luyaluya (*Panicum repens*), and is found in abandoned rice paddies. Another that is highly prized, but obtainable only at the end of the rainy season, is manimanian (*Alsicarpus*). The surprising thing is that, although there is a great demand for grass for horse feed throughout the Islands, there is no attempt to grow any except in the neighborhood of a few of the larger cities.

As long as the rains continue there is no difficulty in securing plenty of green fodder, but as soon as the dry season sets in the grass becomes short, and the stock suffers for want of feed. During the last dry season there was such a shortage in some of the provinces that many animals died from starvation. This might have been prevented had the farmers followed the practice of growing their forage instead of allowing the work animals to seek a living in the cogon fields and jungle near the farm. The Bureau of Agriculture introduced Guinea grass hoping that it would partially solve the problem of furnishing a supply of zacate for the work stock, but most farmers seemed to think that because it was *grass* it needed no attention. If neglected, this grass soon dies out, but, if cared for, it will yield as much as 60 or 70 tons of green feed per hectare during the year.

Pará grass (*Panicum barbinode*) is well adapted to moist ground and will give large quantities of hay or green feed during the dry season.

One great objection to both of the above grasses is that they must be propagated by setting out the young shoots. A stand can not be secured by sowing the seed.

The cultivation of barit for the Manila market may be worth some mention, as the area devoted to it is in the neighborhood of 500 hectares.

This grass is grown under very intensive methods when considered from the standpoint of ordinary grass production.

As frequent and constant irrigation is necessary to carry on this method of grass culture successfully, practically all of the fields near Manila are below the level of high tide and are irrigated from the river or canals at high tide and are allowed to dry during low tide. In order to bring the land to this level as much as one-half meter of soil has been removed from the surface of some of the fields. The fields are surrounded by dikes like rice paddies. In preparing for the planting, the ground is plowed two or three times, a short period being allowed for the grass and weeds to decay between each plowing. It is then harrowed three or four times with the "suyod." At all times the ground is either saturated or covered with water. After the first or second harrowing the ground is left covered with about 10 centimeters of water for several days. The surface is covered with water at the last harrowing so that the soil may be easily reduced to the consistency of soft batter, as by this method all weeds are killed and the paddy is left level. This leveling is necessary as the fields are kept covered with irrigation water practically all the time except during the period that the grass is being cut and taken off. When the field is ready, the grass for transplanting is cut from a field of barit that has been allowed to stand until it throws out seed heads. It is then tied in bundles and taken to the field to be planted. Beginning at one side the bundles are opened and spread on the soft mud very thickly, the base of the stems being pressed down into the mud. The next bundle is then spread on, slightly overlapping the first, so that when finished the field looks as though it had been thatched. (Plate VII, *a*.) Cut and laid in the mud in this way it sends out roots at the joints and begins to grow. It requires the grass from about 1 hectare to transplant 1 hectare of ground. Ten women and eight men are needed to set 1 hectare in one day. Great care is exercised to keep the fields free from foreign grasses and weeds, which are picked out by hand. The missing spots are filled in but in case the stand has been badly injured the field is plowed

up and replanted. The paddies are kept covered with water for a few days until the plants take root, the water being kept moving as in rice culture, after which it is taken off for a time to allow the field to dry.

This is one case where commercial fertilizers of very high grade are used extensively, from 600 to 1,000 kilos being used per hectare. As much as 10 per cent of nitrogen is used in some of these formulæ. The fertilizer is put on just after cutting but is not harrowed in, hence only easily soluble materials are used. Sometimes tobacco dust is used alone as a top dressing.

The grass is cut in eight or ten weeks after transplanting and every six to seven weeks thereafter—depending upon the amount of fertilizer applied—before it reaches the heading stage. A sharp knife very much in the shape of an ordinary grass hook is used for this purpose. The grass is tied in bundles about 6 centimeters thick and these are put up in large bundles—about as much as two men can carry. (Plate VII, *b*.)

The annual yield will vary with the amount of moisture present, the average being about 50 or 60 tons per hectare.

This grass is retailed at the rate of two bundles for one centavo by small vendors who have stands in various parts of the city, and who, in many cases, are only the agents of the owners of the fields. The price of the bundle does not change but the size has been reduced about one half in the last four or five years. The bundles are uniform in size and as it is necessary to keep the grass wet, and thus fresh, it would hardly be practicable to sell it by weight.

Large quantities of grass of various kinds are shipped from comparatively long distances into Manila. From the lake region comes a coarse heavy grass which grows in the shallow waters along the lake shore, used largely for feeding cattle and carabaos. This is cut and loaded on cascos and floated down the river, making transportation very cheap. Various kinds of zacate for horse feed are shipped to Manila by boat from as far away as Santa Cruz, Laguna.

Each kind of grass goes into well defined channels of trade. Certain dealers handle only one kind exclusively.

HAY.

Hay is used in these Islands for feeding American and Australian driving horses. The native horses are fed almost exclusively on green grass. The above statement, however, does

not take into consideration the horses belonging to the United States Army which are fed on imported feed, except for a small amount of green fodder purchased locally. Up to within recent years no attempts have been made to cure any of the native grasses for making hay, although during the last two or three years several parties have been cutting luyaluya and curing it and selling it on the market. Such hay when properly cured has sold readily in Manila at ₱60 per metric ton.

The Bureau of Agriculture has made several tests of Guinea-grass (*Panicum maximum*) and Rhodes-grass (*Chloris gayana*) hay. Guinea-grass is rather difficult to cure and is not adapted to sowing broadcast hence can not be cut with a mower. The hay when properly cured is relished by horses.

Rhodes grass seems to be well adapted to hay making. To get the best results it should be grown under irrigation in a section where there is a pronounced dry season, in order to cure the hay. If it gets wet during the process of curing it will become discolored and lose part of its flavor. Experiments carried on by the division of agronomy at San Miguel, Tarlac, on new soil, demonstrated that under favorable conditions two and one half tons of hay could be secured at one cutting. At Alabang, on rather stiff clay, as an average of two cuttings, the yield was only about two metric tons per hectare. Under ordinary conditions the grass grows up ready to cut again in from six to eight weeks. Two cuttings of hay, ordinarily, and some years as many as three, can be saved. If the average yield were only two tons per hectare, three cuttings would give us 6 tons worth ₱60 per ton, or ₱360 per hectare, at a comparatively small cost.

Hay made from Rhodes grass compares favorably with timothy. However, when exposed to the air for any length of time it bleaches out. This is also true of Alfalfa and other imported hays.

Cured corn-blade fodder makes a very good substitute for hay and some demonstration work has been done to teach the people how to prepare it, although a market is yet to be found. The United States Army has arranged to take a small quantity.

A market for a limited quantity may be found in Manila, Iloilo and Cebu as soon as the people who keep horses learn that the same amount of feed in the form of corn-blade fodder may be purchased at one-half the cost of imported feed.

Hay making is an unknown industry among the farmers of these Islands mainly for the reason that there was little or no



Sugar cane in arrow at eleven months, Alabang stock farm.



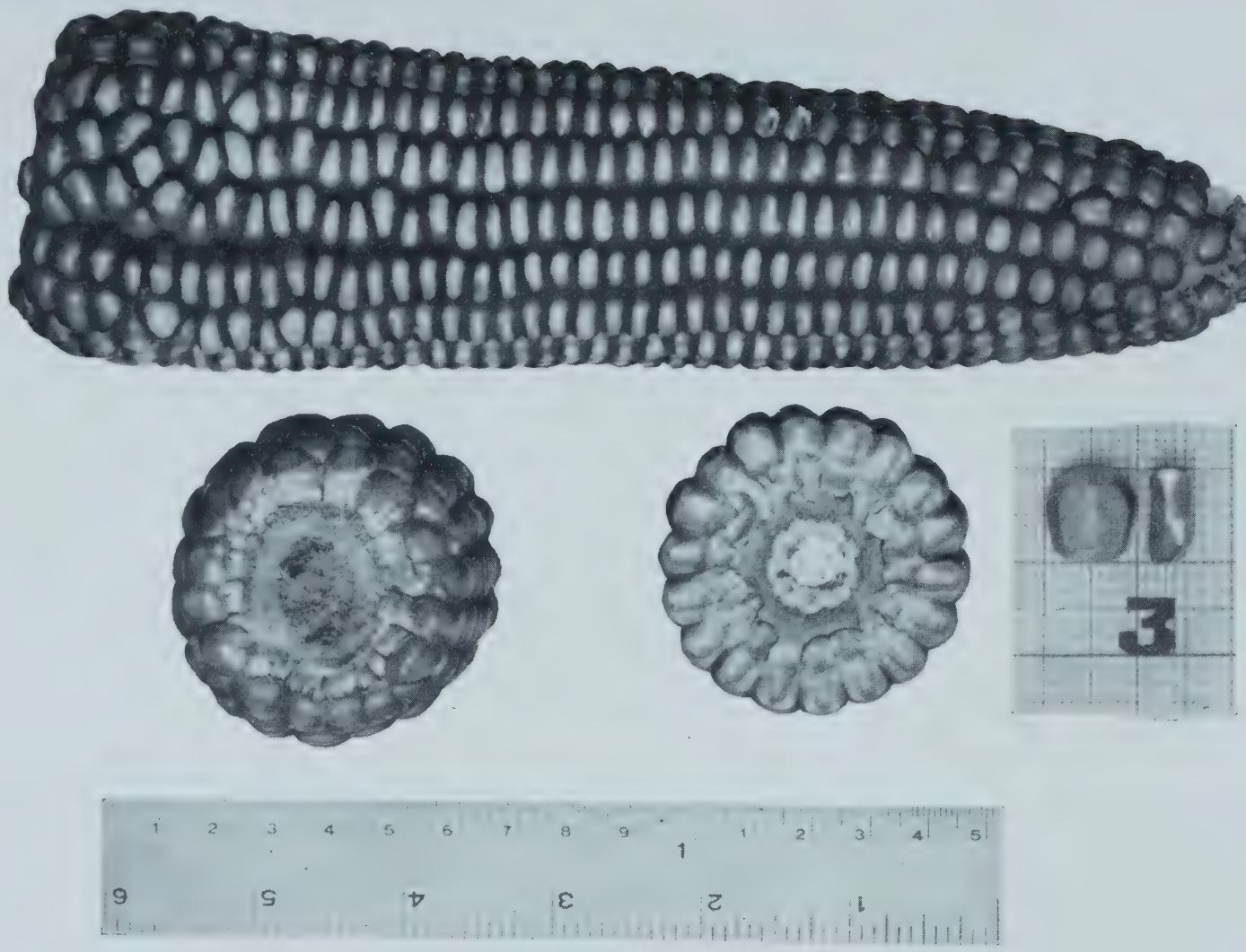
(*a*) Transplanting land to zacate (barit).



(*b*) Cutting zacate for market.



Method of making "rag-doll" test of seed corn.



"Moro"—a new variety of corn.

demand for hay up to a few years ago. These same conditions were found twenty years ago in the Southern States. Now nearly every farm in the Southern States is equipped with hay-making tools, and practically all of the hay used locally is produced there and not shipped down from the north.

There is no reason why good hay can not be successfully made in the Philippine Islands. All it needs to become one of the established industries is that a few pioneers blaze the way.

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DATA CONCERNING VARIETIES OF RICE.

By C. M. CONNER, *Chief, Division of Agronomy.*

In Bulletin No. 22 of this Bureau, only such information was given relative to rice culture as would be interesting to the general public. The following data will be of interest to the student as well as the general farmer.

Some very interesting figures relative to varieties of rice have been obtained by the division of agronomy of the Bureau of Agriculture by grouping the varieties tested under certain heads and charting the results. In recording such results, odd figures were disregarded in order to reduce the number of groups; for example, the yields were grouped in even hundreds, and the figures representing relative size were grouped according to whole number, that is, all fractions being dropped.

The upland and lowland varieties are kept separate. It may be noticed that in some cases the total number of varieties considered is not the same as in others. This is due to the fact that complete data were not available for all varieties and only those that had been tested more than one year were included in the lowland list. However, as these tests were made in duplicate at two separate places and trained men were employed in making the observations and recording the data, the figures should be infinitely more valuable than data collected by untrained observers or made up from estimates furnished by local correspondents.

These data are charted on cross-section paper and appear in the accompanying text figures.

INFLUENCE OF DAYS TO MATURITY ON YIELD PER HECTARE AND FREQUENCY.

(Fig. 3.)

In order to secure some data relative to the influence of *days to maturity* on yield, two hundred and seventy-nine lowland white varieties grown in Indo-China were compared with a like number of lowland white varieties grown in the Phil-

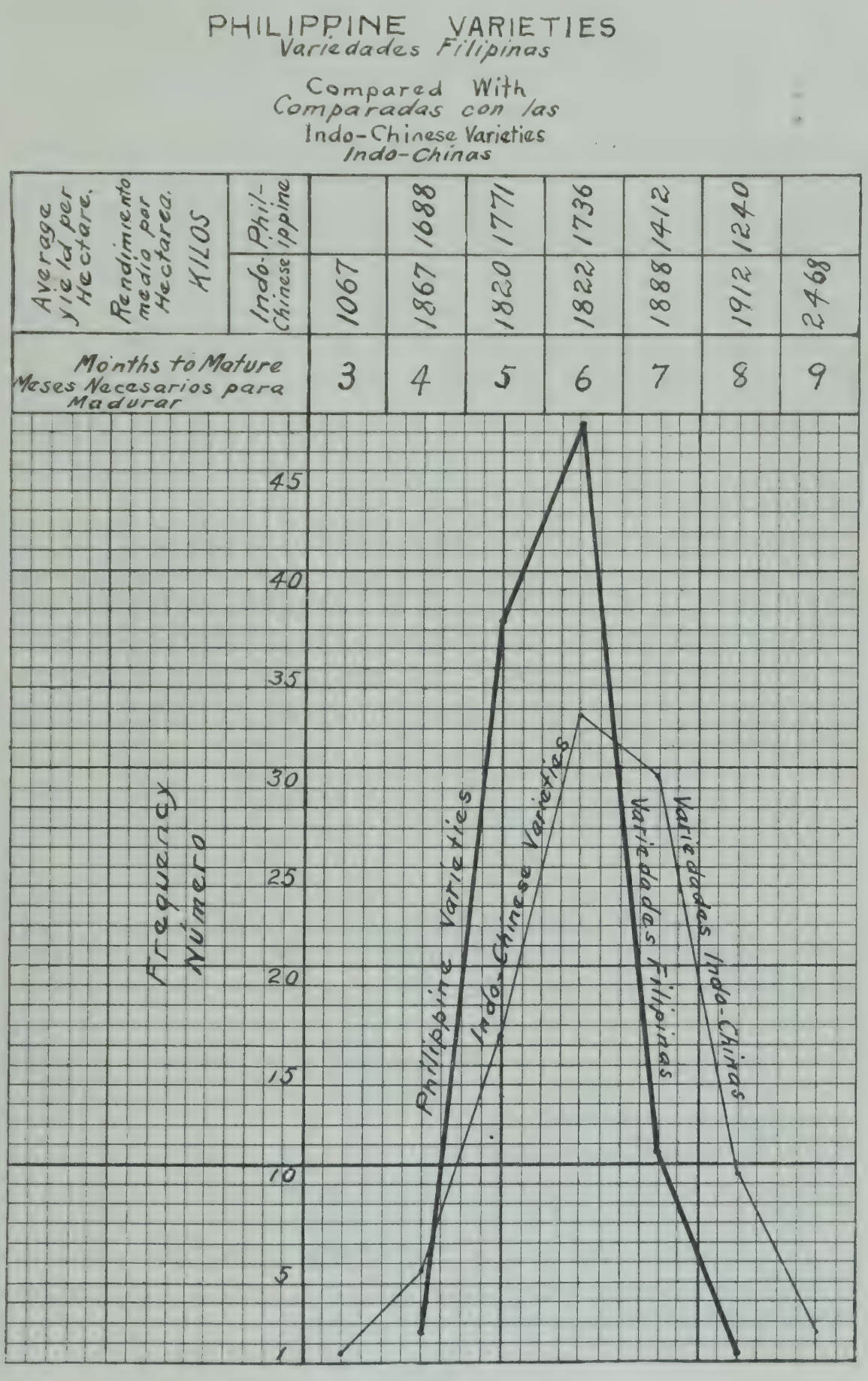

PHILIPPINE VARIETIES
Variedades Filipinas
Compared With
Comparadas con las
Indo-Chinese Varieties
Indo-Chinas
Average yield per Hectare. Rendimiento medio por Hectarea. KILOS
Phil-ippine
Indo-Chinese
1067
1867 1688
1820 1771
1822 1736
1888 1412
1912 1240
2468
Months to Mature
Meses Necesarios para Madurar
3
4
5
6
7
8
9
Frequency
Numero
45
40
35
30
25
20
15
10
5
1
Philippine Varieties
Indo-Chinese Varieties
Variedades Filipinas
Variedades Indo-Chinas

Fig. 3.

ippine Islands. Each was grouped and charted according to the number of months they required to mature. The average yield of the groups is shown at the top of the chart. The figures at the side marked "frequency" indicate the number of varieties included in each group. It will be noticed that the greatest number of varieties mature in six months from sowing. The average yield per hectare does not increase with the number of months to maturity, in fact, months to maturity bears no relation to the yield. In the case of those grown in Indo-China there seems to be a slight increase in the group maturing in nine months but it will be noted that only two varieties occur in this group. It should also be stated that data available for Indo-China are based upon estimates made by observers while those for the Philippine Islands are actual figures obtained by trained men and, in most cases, are averages of three years for each of the varieties.

If varieties maturing in eight months do not give larger yields than those maturing in five months it is difficult to see why the crop should be subjected to destruction by baguios and insect pests for three months when nothing is to be gained by so doing. Again, if varieties that mature in five months were used it would be possible to grow two crops in one year on the same land.

INFLUENCE OF SIZE OF GRAIN ON FREQUENCY, NUMBER OF GRAINS PER HEAD OR RACEME, AND YIELD.

(Figs. 4 and 5.)

In making a description of the varieties, the length and width of the hulled grains were recorded in millimeters and tenths of millimeters. By multiplying the length by the width and dropping the fraction, we have a whole number which will represent the relative size of the grains. For example, a grain 3.2 millimeters long by 2.3 millimeters wide would be represented by seven, and so on.

Grouping the varieties as highland and lowland under heads represented by these figures, and obtaining frequency, which is shown by the numbers on the right hand side of the chart, we notice that there are only a few of the exceedingly small or exceedingly large grains; also that the smallest grains are found in the upland varieties only. There is another interesting point in connection with this which is not brought out in

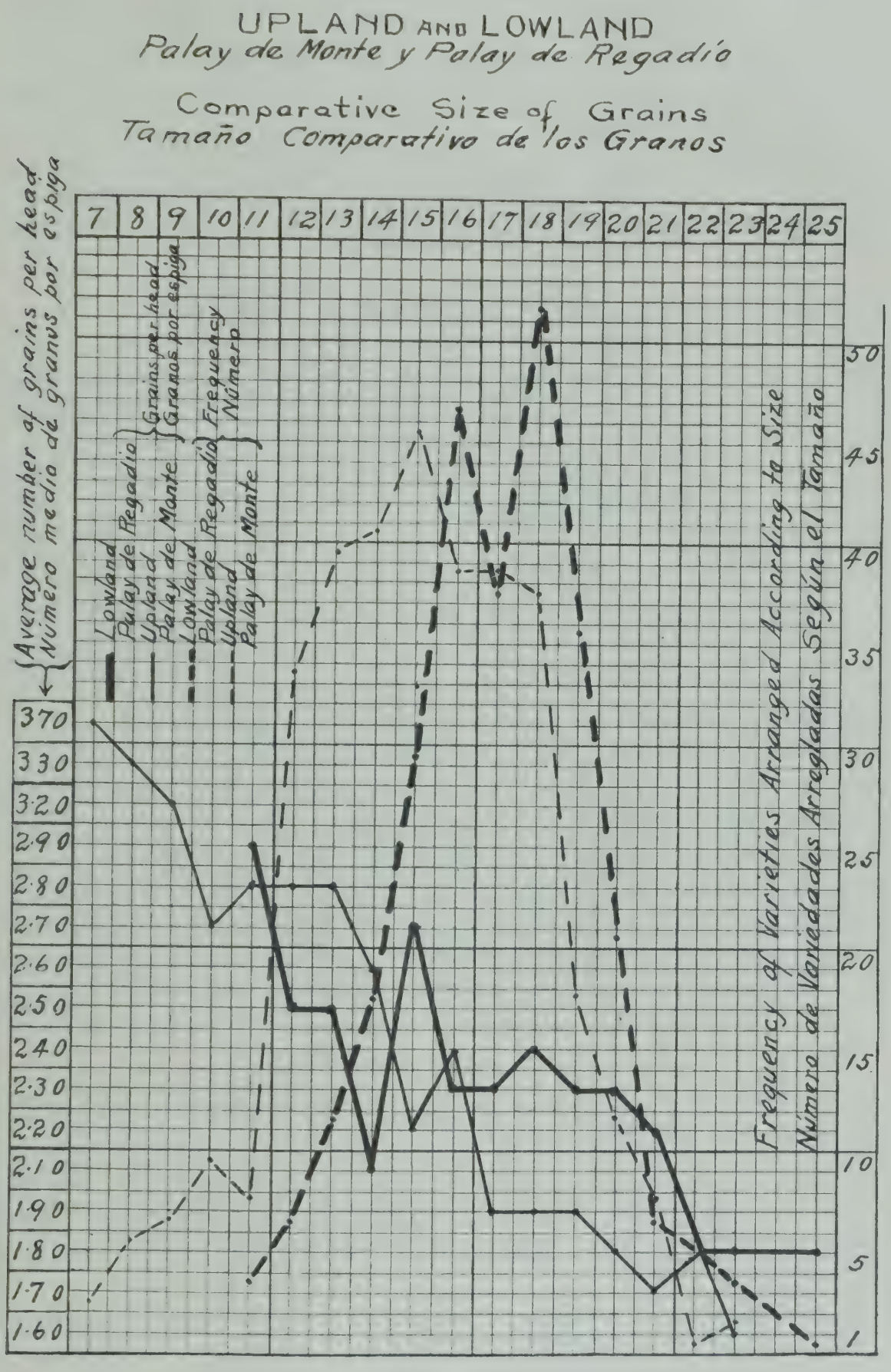

UPLAND AND LOWLAND
Palay de Monte y Palay de Regadío
Comparative Size of Grains
Tamaño Comparativo de los Granos
Average number of grains per head
Número medio de granos por espiga
Lowland Palay de Regadío
Upland Palay de Monte
Grains per head
Granos por espiga
Lowland Palay de Regadío
Upland Palay de Monte
Frequency
Número
Frequency of Varieties Arranged According to Size
Número de Variedades Arregladas Según el Tamaño
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
3·70 3·30 3·20 2·90 2·80 2·70 2·60 2·50 2·40 2·30 2·20 2·10 1·90 1·80 1·70 1·60
50 45 40 35 30 25 20 15 10 5 1

Fig. 4.

the chart,—namely, that practically all of the upland varieties are nonbearded, while a large percentage of lowland varieties are bearded. When we chart the bearded and nonbearded lowland we find that the smallest grains are found to be among the nonbearded varieties.

The great majority may be said to fall in Groups 13 to 18.

Charting the average number of grains per head or raceme, for each of the groups arranged according to size of the grains,

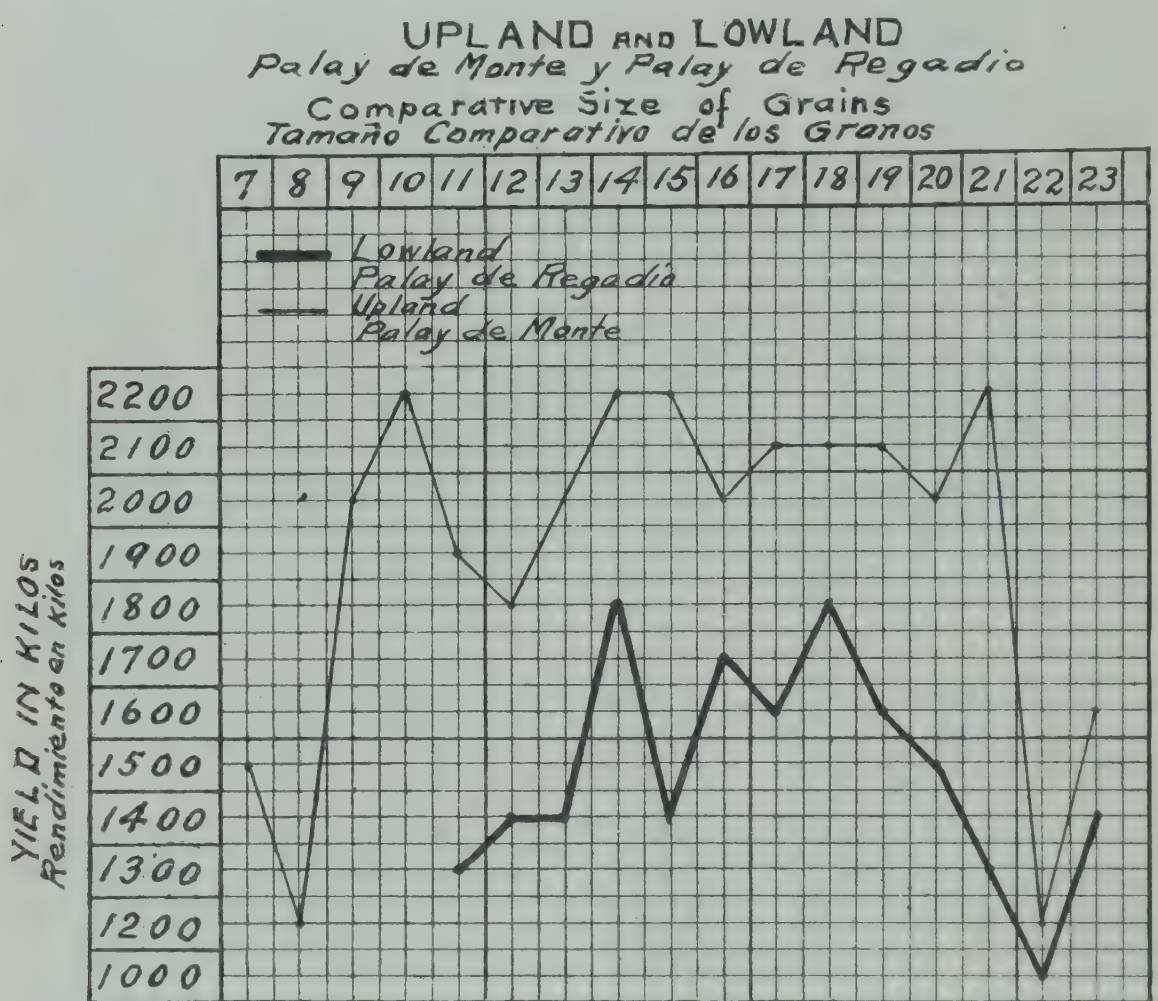


Fig. 5.

we find that the *number* of grains per head is in inverse ratio to the *size* of the grain.

Finding the average yield for each group arranged as above and charting, we notice that the size of the grain has very little influence on the yield except for the very small and the very large grains.

If the above statements prove to be true for future tests it will be possible to furnish the market with any size grains desired without prejudice to the yield.

AVERAGE YIELD AND FREQUENCY.

(Fig. 6.)

Grouping the varieties according to yield for the purpose of obtaining frequency we find that the greatest number of lowland varieties fall within the groups represented by yields of sixteen and seventeen hundred kilos of palay per hectare, while the upland varieties vary with wide limits. If more data were available for upland varieties perhaps the results would be more uniform.

We are frequently asked "What are some of the distinguishing characteristics of upland varieties as compared with lowland?" We have carefully measured the length and width of the leaves of the white nonglutinous nonbearded varieties in both groups and have obtained the following figures:

	Lowland.	Upland.	Increase in upland.	
	Centimeters.	Centimeters.	Centimeters.	Per cent.
Average length of leaf	37.75	53.26	15.51	41
Average width of leaf	1.43	1.72	0.29	20

It was also noticed that the many of the upland varieties had smooth leaves and that the lowland varieties were catchy; that is, if you hold the tip of the leaf in one hand and run the fingers down the blade from tip to base, it feels rough. Making a careful test we find that 1 per cent of the lowland and 40 per cent of the upland have smooth, while the others have rough blades. Practically all the bearded varieties have rough blades. The upland varieties do not stool so freely as the lowland and as a rule have much larger and thicker culms or stalks.

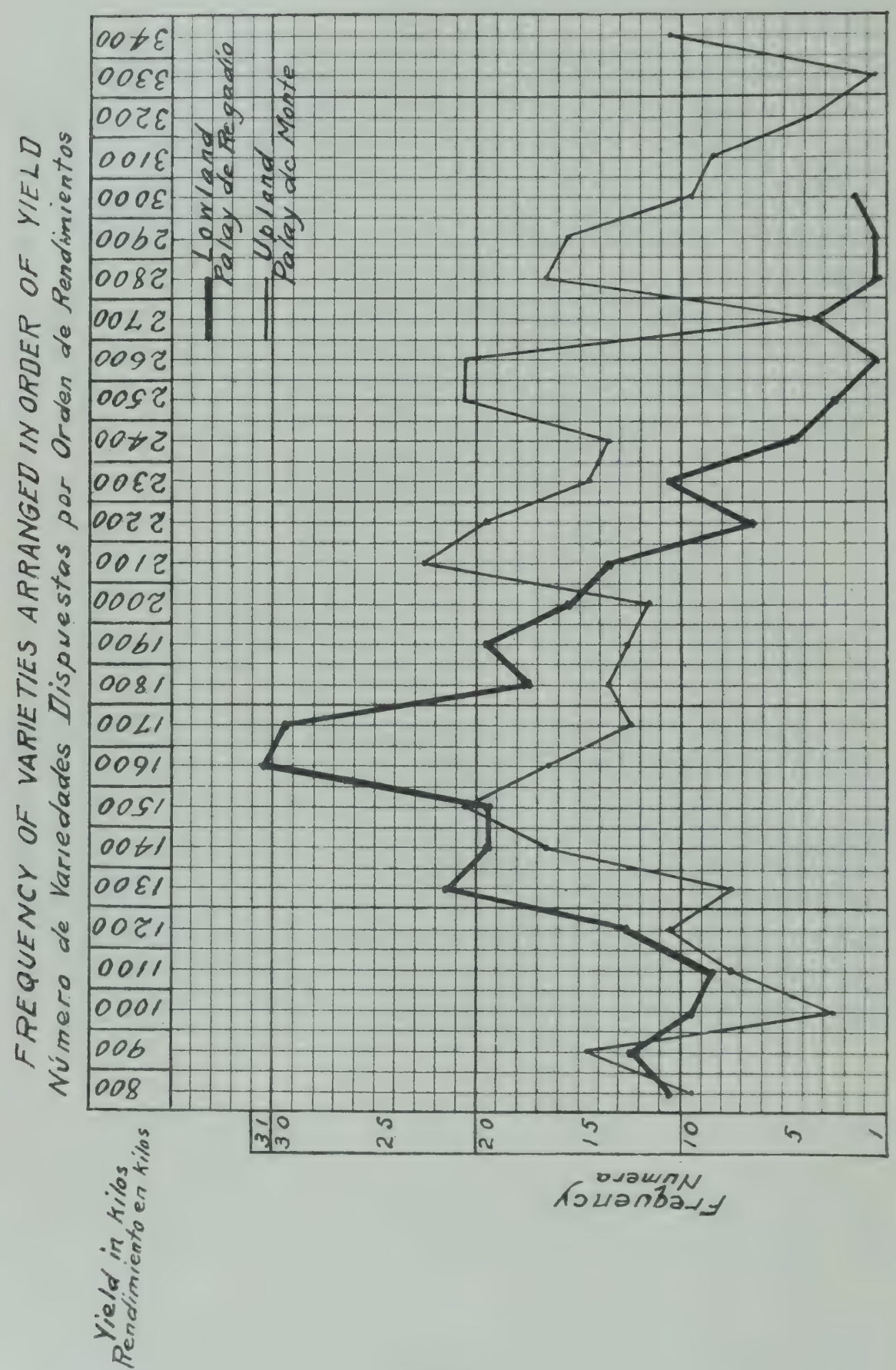

FREQUENCY OF VARIETIES ARRANGED IN ORDER OF YIELD
Número de Variedades Dispuestas por Orden de Rendimientos
Lowland
Palay de Regadío
Upland
Palay de Monte
Yield in kilos
Rendimiento en kilos
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
Frequency
Numero
31
30
25
20
15
10
5
1

Fig. 6.

THE "RAG-DOLL" TEST FOR SEED CORN.

By Henry O. Jacobson, *Agricultural Inspector.*

A method of testing seed corn for vitality which is eminently suited to Philippine conditions is a modified form of the so called "rag-doll" test.

This method was used by the writer fifteen years ago in testing tobacco and small grain seed, and was found more convenient than the plate-and-blotter method commonly used; in fact, a more convenient, economical, speedy and reliable method is yet to be devised.

The materials necessary are a strip of cloth 25 centimeters wide and 3 centimeters in length for each ear to be tested, one round wooden or bamboo stick 30 centimeters long and 2 to 3 centimeters in diameter, and a small quantity of strong twine.

The cloth may be cheese cloth, of double thickness, or canton flannel of single thickness. In fact, any kind of cloth may be used, but a white, fairly loosely woven and inexpensive cloth is preferable.

The first step in the operation is to place the selected seed ears in such order that each ear will have a permanent number during the test. This can be accomplished by tying 15 or 20 ears together on a strong twine, and attaching a label to the first ear of each string, on which is written the permanent number of that ear. Thus when the ears are tied together in units of twenty, the first ear of the first string will be No. 1, the first ear of the second string will be No. 21, and so on. When the first ear is numbered, the number of any other ear on the string can be readily determined. Furthermore, this method positively prevents any disarrangement of the ears, is easily manipulated, and is available at all times and places.

The next step is to prepare the "rag doll" for receiving the kernels of corn.

Spread the strip of cloth smoothly on a table or the floor, smoothing out all wrinkles and place the round stick across one end, giving it a turn so as to start the cloth winding around

the stick. It is a good idea for the novice to rule the strip crosswise into sections of 3 centimeters each, and number each space to correspond with the number of the ear, using an indelible pencil for the purpose.

The string of ears being suspended, it is easy to remove the necessary kernels for the test. For detaching the kernels from the ear the most convenient instrument is a knife having a small, stiff, dull blade. Insert the blade between the rows of kernels and gently pry out the kernels wanted. In this way no injury will be done to the germ, which may occur if the knife blade be thrust into the flat side of the kernel where the germ is less protected.

Do not use kernels from the extreme tip or butt end of the ear since these are generally discarded in order that the seed may be more uniform in size. Remove four or five kernels from each ear, following a spiral course around the ear from one end to the other. In this manner a sample is secured of each equal division of the ear when considered from the standpoint of length or circumference.

Securing the sample kernels from ear No. 1, place them in a row in the No. 1 space on the cloth about 2 centimeters from the left edge of the strip. The kernels from ear No. 2 are placed in the center of the No. 2 space, and the kernels from ear No. 3 in the No. 3 space about 2 centimeters from the right edge of the strip. Now grasp the stick and roll it forward, using care to keep the cloth stretched fairly tight and to see that the kernels remain in their proper position. (Plate VIII.) Proceed in this manner until the roll is completed.

It is neither advisable nor convenient to make strips longer than 3 meters, since this length will accommodate one hundred ears.

When the roll is completed wind a string around it tightly and submerge it in pure fresh water, allowing it to remain therein for forty-eight hours.

At the end of this period the roll is taken out of the water, making no effort to get rid of the surplus water, and suspended in a shady, warm and well ventilated place. It has been found that suspending the roll one-half meter below an iron roof gives excellent results, since the iron roof maintains a degree of heat for a considerable period of time after the sun has gone down. Another good method where ants are to be guarded against is to bury the roll in sand out in the open, just barely covering it over.

In from three to five days the corn will have germinated sufficiently so that it can be easily seen, when the roll is opened, what kernels are dead or of low vitality.

If it is desired to use the cloth again for another test it should be boiled in water or spread out in the bright sunshine for several hours, as either method will destroy any undesirable bacterial or fungus growth. Thus the same cloth may be used repeatedly.

It will be found, when a large number of ears are to be tested, that this method will give better results, with less room and materials, than any other.

A NEW VARIETY OF MAIZE.

By C. M. CONNER, *Chief, Division of Agronomy.*

A new variety of maize which is a cross between Mexican June and a native white maize was exhibited at the last Carnival by the Moro Province. For want of a better name it is called "Moro." The ears average about 19 centimeters long and 5 centimeters thick at the center and have sixteen rows of grains. Two hundred and thirty ears fill a cavan [1] measure while it requires about four hundred and eighty ears of the average Laguna maize to shell one cavan. The majority of the ears are inclined to be cone-shaped but this can be corrected by selection. The buts and tips are well filled out. The grains are white, hard and flinty except for the tips, which have some soft starch. They average 8 millimeters wide by 9 millimeters long. The germ is quite large as compared with the size of the grain.

Plate IX shows a view of the ear two-thirds natural size and in the lower right-hand corner the grain appears natural size.

This variety of maize makes good meal and hominy and should prove quite popular in the demonstration work.

Some preliminary tests have been made and the average yield is found to be much better than the small native varieties.

A large quantity of this maize has been purchased by the Bureau and will be distributed free throughout the Islands.

[1] One cavan is equal to 75 liters.

SALT-WATER RICE.

By C. M. Conner, *Chief, Division of Agronomy.*

On returning from an inspection trip, Mr. H. E. Guyer, superintendent of schools, Tacloban, Leyte, saw a field of rice near the seashore which apparently was covered with sea water. Upon inquiry he was informed that the rice was irrigated with sea water and that this had been done for some years.

Upon request, Mr. Guyer furnished the division of agronomy with 10 kilos of seed of this variety.

The seed palay as received was mixed, a part of it being red. The red and white grains were separated and one set of four tubs was planted with the white and one set with the red.

These tubs were watered as follows:

No. 1.—With fresh water.

No. 2.—With solution of 10 per cent sea water.

No. 3.—With solution of 25 per cent sea water.

No. 4.—With solution of 50 per cent sea water.

As soon as it was evident that the salt water was doing the plants no harm, the tubs receiving 10 per cent were given 75 per cent with no apparent ill effects.

The plants receiving fresh water made a more vigorous growth at first but at harvest time there was practically no difference in the height of the plants in the different tubs. The leaves of those plants growing in the salt water had a darker color than those in the fresh. At harvest time the plants growing in the salt water filled out and the rice seemed to be of good quality.

If this rice can be grown successfully, then thousands of hectares of land which are now overflowed by the tide may be made to produce two crops of palay each year at small cost, as irrigation will not be expensive.

A few of the plants in the tubs receiving the salt water died but it is not certain that the salt water killed them. This test will be repeated on a large scale.

CURRENT NOTES—FEBRUARY.

NOTES BY M. M. SALEEBY, Chief, Fiber Division.

TERMINOLOGY FOR PHILIPPINE FIBER PRODUCTS.

The need for a uniform and correct usage of the terminology of the commercial fiber products of the Philippine Islands has long been felt by the Bureau of Agriculture. The PHILIPPINE AGRICULTURAL REVIEW and the bulletins, circulars, and other publications issued by this Bureau, though primarily intended for the benefit and guidance of the Philippine farmers, are also distributed to commercial and scientific institutions both in the Philippines and other countries. It is therefore essential that the terms used in them to designate the fiber products should be such as would be easily understood by all perusers, whether native or foreign.

Special Order No. 9, series 1912–13, recently issued by the Director of Agriculture, prescribes the terms which should be adhered to in all official correspondence and publications of this Bureau, to the exclusion of others heretofore used indiscriminately. The text of the above order is here reproduced:

Abacá.—The term "abacá" is used in the Philippine Islands to designate both the plant and the fiber. The terms "Manila hemp," "hemp," and "manila," are commercial terms used in the United States and some foreign countries to designate the fiber alone. Of these terms "hemp" and "manila" are both inaccurate and misleading, and should on no occasion be used by this Bureau. The term "Manila hemp" is more generally known throughout the commercial world than the above-mentioned two, and it should be used in preference to them. The term "abacá," being the only accurate and distinctive term which is most generally known in the Philippines, should also be used in connection with the commercial term "Manila hemp," the latter forming a parenthetical expression to the first, thus, "abacá" (Manila hemp). This form should be adhered to on all occasions, excepting in instances in which the term is referred to more than once in any one article or report, when subsequent reference should be made by the use of the term "abacá" alone.

Maguey.—The term "maguey" and "Philippine maguey" are used to designate the fiber produced by the native maguey plant of the Philippine Islands. Either of these two terms can be used. In articles or bulletins, prepared for publication, the first reference to the article should be made

by the use of the term "maguey" (cantala) and subsequent references by the use of the term "maguey" alone. If the product, however, is known to be that of the sisal plant recently introduced from Hawaii, it should be designated by the term "sisal" or "Philippine sisal" in the same way as the term "maguey" (cantala) and "maguey" are used. It will also be proper to use the term "Philippine maguey" (cantala).

Kapok.—The terms "raw cotton" and "tree cotton" are sometimes used to designate this product. These terms are both inaccurate and misleading, and should never be used when referring to kapok. The term "kapok" is the correct term, which alone should be used in all instances. The word should be written with a final "k" instead of "c."

If on any occasion it is deemed advisable to use any local Philippine term in connection with the term "kapok" the former should be used after the latter and inclosed in parenthesis, such as "kapok" (doldol), etc.

The terms to be used for designating the other commercial fiber products and manufactures of the Philippines, such as hats, cloth, etc., are still under discussion between this Bureau and the Bureau of Customs, and they will be published in a similar manner as soon as they are determined. This Bureau earnestly hopes that the press, the commercial community, and the producers in the Philippine Islands will adopt the terms prescribed in the above circular so that uniformity in nomenclature may prevail.

PROPAGATING ABACÁ (MANILA HEMP) FROM SEED.

Until very recently the propagation of abacá from seed was considered extremely difficult, impracticable, and of doubtful results. This belief was not entertained by the planters alone, but also by the several men in charge of the fiber division of this Bureau, including the writer. Recently, however, experimental plantings of abacá from seed made in connection with an extensive series of fiber experiments at the La Carlota experiment station have so far given such unprecedentedly good results as to entitle this method to a more serious consideration than it has heretofore received.

The experiments in question constituted a separate group of plots included in the section set aside for experiments in abacá varieties from the principal abacá districts of the Philippines. The varieties of each district occupied two groups in the section, one for reproduction from seed and the other from rootstocks.

The varieties of southeastern Mindanao were the first to be planted, and the rootstocks were set out in the permanent plots prepared for them at the same time the seed was planted in the nursery. The seed pods, or fruits, were secured from the same varieties as the rootstocks and were transported in the fruit to

the station, where they were thoroughly cleaned and immediately planted in germinating boxes specially prepared for them.

Seeds of the following Mindanao varieties were planted: *Maguindanao, Tangongon, Libuton, Punucan, Baguisanon basag, Baguisanon lawaan, Pulajan, Agutay, Sinabá,* and *Bangulanon,* the first variety and the last one failing to germinate at all, while a very low percentage of germination was obtained from the *Agutay* and the *Maguindanao.* The highest percentage of germination and the quickest growth were exhibited by the *Pulajan, Baguisanon lawaan,* and *Tangongon* varieties, in all of which the growth of the abacá plant is known to reach its maximum extent.

Abacá seed does not retain its vitality for any considerable length of time unless it is carefully preserved, and even then three months have often proved to be too long a period. The best results are obtained from fresh seed which, for this reason, must be transported in the fully developed, but not over-ripe, fruit (seedpod), if it is to be transported from one province to another. This, however, does not apply to its transportation to countries outside the Philippines where more than three weeks are required to reach its destination. For this latter purpose it is best to pack the freshly cleaned seed in a manner similar to that used with other seeds.

The seed should be first planted in germinating boxes. The soil should be very fine and kept moist practically all the time until germination shall have begun. During this entire period the germinating boxes should be placed under complete shade, and after germination, under half shade. Daily watering and constant attention are required until the seedlings have attained the height of about 30 centimeters, when they are ready to be transplanted into the nursery. This stage of growth is usually attained in about three to six months, depending on the quality of seed, the care given the seeds and seedlings, and the variety, but more especially on the last.

The nursery should be very carefully prepared and kept clean from weeds all the time. Before transplanting, the leaves of the seedlings should be all cut back leaving about one-third of each. The seedlings are set out about 20 centimeters apart in the row, and the rows about 40 to 50 centimeters apart. If the rain is not regular and frequent, watering every day is necessary. The seedlings thus planted will continue to grow unchecked, and in four to five months they are ready for the second and last transplanting to the permanent field. If the roots are not muti-

lated in digging up the plants, and if their leaves are again cut back, the seedlings will take root and continue their growth in a surprisingly short time, providing, of course, the soil around their roots is kept loose and moist during the first week.

The Mindanao varieties propagated from seed by the method briefly described above occupy a group of plots adjacent to that planted with the same varieties from rootstocks. Both groups are given the same treatment, and their soil, of course, is identical. The final results, after the varieties in both groups shall have attained maturity, promise to be of great interest, and data and facts, heretofore undetermined, will surely be of value to the growers of abacá all over the Islands. Until these experiments were started, it was a common belief that abacá reproduced from seed requires a year longer to come to maturity than when reproduced from rootstocks or shoots. This belief may already be said to have been disproved for the plants reproduced from rootstocks do not average more than about four months ahead of those from seeds.

FIRST CROP OF MAGUEY (CANTALA) AND SISAL.

The first harvest of leaves from the maguey and sisal plants is always of a much poorer quality than subsequent harvests. This is due to the fact that the first and oldest leaves are always considerably shorter and often more damaged than the later ones, besides being often partly dried up. For these reasons the first crop of fiber is both too short and improperly cleaned, and does by no means represent the quality of the subsequent crops. Besides, such crops almost invariably leave in the minds of buyers a bad impression which may take several crops to overcome.

In order to avoid such occurrences the producers of these fibers, especially those who use or intend to use machinery for cleaning the fiber, should be careful in so marking their first crop as to show that it is not a representative sample of subsequent crops, thereby avoiding future sacrifices on their part.

Attention has recently been called to this important fact by Mr. L. H. Dewey, who cited a recent case of this kind occurring in Hawaii.

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

THE VALENCIA ORANGE TRADE.

From our very modest little tangerine traffic of the Province of Batangas we can look up with respect and admiration to the trade in Valencia oranges which now amounts, according to the

Daily Consular and Trade Reports of Washington, D. C., to some 450,000 tons annually. Of this tremendous quantity, all but some 12,000 tons or so are exported by sea to northern Europe, and most of the remainder is exported by rail into France. The Valencia orange district is some 325 kilometers long by 25 to 35 kilometers wide; in this area are grown 90 per cent of all the Spanish oranges.

The Valencia oranges are far superior to the other Spanish varieties and the so-called "Valencia Late" is now one of the best kinds in California and Florida. (A few plants have been introduced into the Philippines but without much success thus far, though it is hoped that the budded plants at the Lamao experiment station will soon make a good showing.) In this famous district the good plantations yield at the rate of ₱4,000 to ₱6,000 per hectare. Needless to say, all the trees are budded stock mostly on "sour lemon," though in the damp, heavy soils the "sour orange" is preferred; this should be a lesson to the Batangas naranjita growers who are risking serious loss by the gum disease in their using only seedling plants. Fertilizers are, of course, used heavily, although the expenses in this line amount to only some ₱200 to ₱300 per hectare per year.

The famous "Seville," or bitter orange, of southern Europe, is now used largely in preparing a concentrated pulp which is shipped in 5-kilo tins to London, there to be used in making the justly famous "Scotch orange marmalade."

AVOCADO COMMERCE.

Florida, Cuba, and Porto Rico have been supplying most of the demand for this excellent fruit in the Eastern States—Mexico to a certain extent supplying the California trade, of course, and a few coming into California from the Gulf ports. Recently, however, the demand for this fruit has been so great that middlemen can afford to risk long-distance shipments from the British island, Trinidad, at the mouth of the Orinoco River, to New York; large shipments are now being made from that island with considerable loss in transit, of course, but with a fair profit to the middleman. The first price is only ₱0.10 per fruit and the wholesale market price in New York at least ₱0.30—the retail being double or more the wholesale price.

As might be expected from the various introductions from all parts of North and South America and the West Indies, a number of very interesting types, from the apple-shaped to the long bottlenecked type, are in evidence.

EAST AFRICAN COCONUTS.

Besides the very heavy planting which is now going on in the state of Quelimane, or, as it is popularly called, Zambezia, in the Portuguese colony of Mozambique, there is considerable activity notable in other East African countries. For instance, Zanzibar, famous in the past as the clove garden of the world, is now becoming more interested in coconuts. On account of faulty cultural methods the clove gardens of that archipelago have for the last six or eight years been deteriorating and although the whole Zanzibar Protectorate, including the large island of Pemba, still produces nearly four-fifths of the clove crop of the world, together with considerable cinnamon and black pepper, the thrifty Hindu agriculturists are crowding out the old-fashioned Swahili native planters.

CHINESE NARCISSUS.

Almost everyone is familiar with the so-called "Chinese Lily," this being one of the very few bulbs which can satisfactorily be flowered in a dish of pebbles and water. These bulbs, which are really nothing but a special variety of Paper White, or Polyanthus, Narcissus, are grown almost entirely in the district of Chang-Chow, near Amoy in South China. They are grown by a special method in the rich alluvial soil to which a special fertilizer is added. The crop is of great importance to European and American florists, but unfortunately this variety of narcissus can not be profitably raised either in Europe or America.

The crop is reported to be unusually good this season, and bulbs which generally bring some ₱18 per thousand in Amoy have been selling for only ₱12 to ₱14 per thousand. It is interesting to note that middlemen absorb most of the profits between the producers' price of ₱0.01 per bulb and the retail florist's price of ₱0.20.

RARE FORMOSAN TREES.

The dendrologist sometimes has the unique pleasure, or perhaps sorrow, of contemplating all the known specimens of certain species of trees at one glance; this occurred some years ago, for instance, on one of the small islands off the coast of Southern California. We now learn of two other cases in northern Formosa; the most striking being the Shimamomi (*Keteleeria davidiana*), there being only one small cluster known to exist in the island; a still more striking case is that of the *Cunninghamia konishi*, of Mount Randai: of this tree it appears there are only five living specimens known.

GOATS.

The humble goat is deplorably unpopular in most of the districts of the Philippines. To be sure it does sometimes require fencing, it does occasionally die from disease, and most of the sorts raised here are of little use for milk production; but there are other goats and other methods.

In Mexico small herds of goats are very common, especially in the Pedregal, or lava-field districts of the Mesa, throughout the interior of the Republic. These herds are frequently neither fenced nor sheltered—save, perhaps, by the overhanging lava masses about which the corrals, or night pens, are built. These goats are used not only as meat animals but as milk, and even cheese, producers. The cheese and milk are frequently combined with sugar in the preparation of various sorts of "dulces." Cattle could hardly exist in the Pedregal country because of the sharp rock edges which would soon wear out the hoofs of any large animal.

In Belgium 425 new Goat Improvement Syndicates are announced with 40,260 members who own about 50,000 goats. Realizing that the average husbandryman does not know much concerning the points of a good goat and cares less for the pedigree, these syndicates are endeavoring to popularize the industry and give practical demonstrations to the farmers. Breeding registers are kept by the secretaries who also collect the nominal service fee (₱0.20) and who arrange for the purchase of the best kids, for breeding purposes, at ₱0.20 to ₱0.30 per head. The syndicates are united into provincial federations.

Such a system unquestionably makes for breed improvement and financial success. The Philippines greatly need the benefits which the Belgium system will bring.

A NEW EARTH NUT.

A new earth nut, or ground bean, has recently been discovered in West Africa. This is related to the peanut and the so-called Bambarra nut of East Africa, Madagascar, and the East Indies. The new plant is known as *Voandzeia poissoni,* or *Kerstingiella geocarpa.* This new cousin of the peanut is of considerable economic importance to the natives from Dahomey to Nigeria, though to the women of the former country it is tabooed. The Bambarra nut (*V. subterranea*) has just been discovered in a wild state. By the way, the writer has seen it growing practically wild in the "bush-veld," or open forest, in the state of

Inhambane, Portuguese East Africa, in which region it is also frequently cultivated by the Kafir tribes, and sometimes may be seen growing side by side with the other earth nut, a variety of the common peanut resembling the "Spanish" type.

THE WORLD'S PRESENT SUGAR CROP.

From the Boston News Bureau we learn that the world's present sugar crop is a record one and that there is a good outlook for a 15 per cent increase for the coming season. The estimate for this crop is 15,880,000 tons, and the chances are that the next crop will run to well over 18 million tons. The Cuban crop just finished will total nearly 2 million tons; this is away ahead of the 1911 crop. The European beet-sugar output is estimated at some 8,600,000 to 9,000,000 tons for this season.

The Philippines produce only about one-seventy-fifth of the total sugar crop.

GARBANZO OR "CHICK PEA."

All over the world there is a renewed interest in the garbanzo, or "chick pea." Europe takes a tremendous amount from India and now the United States is importing large quantities from Mexico. The crop from northwest Mexico is greatly in excess this season over the 1911 crop. Some 22,000 tons have been exported through the port of Nogales during the season just closed while during 1911 there were only some 6,500 tons so exported, or less than a third of the present amount.

In New York the garbanzo is now used as a confectionery material; the seed is roasted and dipped in various sugar preparations just as almonds are coated for the candy trade. The idea is borrowed from the Levant where this richly flavored seed has long been much appreciated.

In certain districts of west central Mexico visited by the writer in 1899 a very high grade of garbanzo is grown for export to Spain, although the bulk of that grain consumed in Mexico is imported from Spain.

NOTES BY C. R. JONES, Entomologist.

A NEW COCONUT PEST.

Promecotheca cumingii Baly.

Attention has been called to a new insect infesting the coconut palms, belonging to the family Chrysomelidæ, subfamily Hispidæ, which contains our most destructive leaf-eating beetles.

The members of this sub-family vary greatly in general structure but may be easily recognized by the V-shaped position in which the antennæ are carried.

The injury caused by this beetle is not restricted to the larval stage alone but the adult also feeds upon leaflets, slitting them longitudinally.

The larva is a true leaf-miner, even the pupa stage being passed within the tissue of the leaf.

The eggs are deposited singly on the under side of the leaflets, and generally on the lower leaves of the young palms, the female having previously eaten a small hole through the tough epidermis so that the young grub can enter the soft parenchyma immediately upon hatching. The egg is cemented into place by a glutinous secretion which soon turns a brownish color. The larvæ are pale green, footless grubs about 9.5 millimeters in length when full grown. In feeding, a more or less irregular oblong chamber is formed, and it recedes to the center of this to pupate.

The injury caused by the larvæ is greater than that caused by the adults; the combined attacks of both give the infested palm an unhealthy or blighted appearance.

As yet the ravages of this beetle are more or less local but it has been found from the Cagayan Valley in Northern Luzon to the Visayas in the south.

The eggs, larvæ and pupæ are highly parasitized, the infestation being over 50 per cent. Without the control exercised by these (hymenopterous) parasites, this leaf-miner would undoubtedly become a rather serious coconut pest; however, should this beetle increase in such numbers as to cause a serious outbreak, its habits are such that its control could probably be easily accomplished by collecting and destroying the infested leaflets.

KEROSENE EMULSION AND LOCTONES.

During the past month in Negros Occidental several experiments were carried on to test the effectiveness of kerosene emulsion on young locusts in cogon and grassy areas. A stock solution diluted to one-half to one-fifth was used, and liberal applications were made using about five times the supposed requisite quantity. The applications were made during the evening when the hoppers were concentrated upon the grass. While numerous loctones were killed the percentage *in no case was over fifty per cent.*

INJURY TO RICE ERRONEOUSLY ATTRIBUTED TO INSECTS.

Up to October 10, 1912, the superintendent of the demonstration station at Iloilo had received numerous reports regarding insect injury to rice in the Provinces of Iloilo and Capiz. From the reports received from Capiz it would seem that the entire crop was being destroyed by insects, so it was deemed advisable to make an investigation of these infested areas.

At Capiz after a conference with the governor the supposedly infested fields were inspected and it was found that the rice was attacked by the horned rice caterpillar (*Melanitis ismene* Cram.), the rice grain bug (*Leptocorisa acuta* Gem.), the rice Caterpillar (*Spodoptera maurita* Boisd.), the rice stemborer (*Schœnobius punctellus* Zell.), and two species of Coccinellidæ. As is always the case, these insects could be found in almost every field but not in sufficient numbers to warrant alarm.

There occurred in many rice fields strips of fallen grain due undoubtedly to the fact that the stem was unable to bear the weight of the grain—this year being an exceptionally favorable year for rice production in these sections—and not to the "stalk-borer" nor to any of the other insects named above, as was supposed. This "lodged" condition was obvious in numerous fields along the railroad from Pototan to Capiz. The fact that the rice stalks were in a compact mass wherever they had fallen, and the decomposing of same caused by the heat, lead to the belief that the injury was caused by insects.

PRINCIPAL PHILIPPINE IMPORTS AND EXPORTS—NOVEMBER.

By the INSULAR COLLECTOR OF CUSTOMS.

(Values in dollars United States currency.)

IMPORTS.

Articles.		Manila.	Cebu.	Iloilo.	Totals.
Rice	Kilos	12,087,325	1,520,360	1,710,656	15,318,341
	Value	531,418	54,393	68,206	654,017
Beef cattle	Numbers	1,013			1,013
	Value	22,186			22,186
Eggs	Dozens	339,652	317	161	340,130
	Value	28,038	30	22	28,590
Sugar	Kilos	277,976	55,849	27,066	360,852
	Value	22,970	5,602	2,034	30,606
Coffee	Kilos	64,175		1,188	65,863
	Value	20,726		430	21,156
Cacao	Kilos	57,297		430	57,727
	Value	18,651		162	18,813
Raw cotton	Kilos				
	Value				

EXPORTS.

Hemp	Kilos	8,741,831	1,419,828		10,160,659
	Value	1,427,822	262,449		1,690,271
Copra	Kilos	12,509,178	1,964,608	280,992	14,754,778
	Value	1,227,810	191,798	23,180	1,442,788
Sugar	Kilos	2,166,611	1,036,302	5,535,980	8,738,893
	Value	98,787	48,445	227,992	371,174
Cigars	Thousand	9,017			9,017
	Value	160,185			160,185
Cigarettes	Thousand	4,699			4,699
	Value	6,552			6,552
Tobacco	Kilos	1,739,283			1,739,283
	Value	277,992			277,992



Horse sheds, Batangas live-stock show, Batangas, Batangas, January 16, 17, and 18, 1913.

THE PHILIPPINE

Agricultural Review

VOL. VI MARCH, 1913 No. 3

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CONTENTS.

	Page.
Editorial	113
Bureau of Agriculture Circulars:	
No. 19, Maize Pests	115
No. 20, The Mango Bark Borer	118
The Situation in the Citrus District of Batangas	125
The Batangas Live-stock Show	131
Popularity of Banana Food Products	137
The Calthrops	140
Current Notes—March: Fruit Flies; Tomato-leaf Beetle; Corn Stalk-borer; Locust Situation in the Visayas; Lemon Industry in Italy; Sapucaia Nut; Sugar Industry in Formosa; Fruit Exports of Porto Rico; New Catch Crop; New Plow; Silk Industry in Madagascar; Caviar; Sunflower Potash; Brazilian Rubber; New Stock Food	141
Book Review: "The Flora of Manila"	149
Temperature and Rainfall for Agricultural Districts in the Philippines—December, 1912	151

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ILLUSTRATIONS.

PLATE I. Horse Sheds, Batangas Live-stock Show ..... *Frontispiece*

Facing page—

II. Typical appearance of mango trunk attacked by bark borer 118
III. Mango trunk showing effects of bark borer 118
IV. Mango tree killed by bark borer 118
V. Trunk of mandarin tree affected with barkrot 126
VI. Same as Plate V, with flakes of dried bark removed 126
VII. Portion of branch of orange tree attacked by barkrot 126
VIII. Typical young mandarin grove in Santo Tomas, Batangas 126
IX. Mandarin grove dying of barkrot 126
X. Prize winners, Batangas Live-stock Show 134
XI. Prize winners, Batangas Live-stock Show 134
XII. Calthrops 142

TEXT FIGURES.

Page.

FIG. 1. Method of applying poison to maize for maize "worms" 117
2. The mango bark borer 121

EDITORIAL.

PROVINCIAL FAIRS.

There has recently been held in the municipality of Batangas a very successful live-stock show, a report of which is published in this number of the REVIEW. It appears that some exceptionally fine animals were exhibited at Batangas and that great interest was taken by the people of the province in this show.

In provinces other than Batangas preparations are now being made for the holding of provincial fairs; in the city of Manila the annual Carnival has just been held; and, as a matter of fact, throughout practically the entire year we find that provincial or municipal shows and expositions are either being prepared or are being held in some part of the Archipelago. Inasmuch as these fairs are coming to occupy such an important place in both the social and the industrial life of the Filipino people, it is highly desirable that they be so organized and so managed as to yield results commensurate with the expenditure of time and money which they entail.

We believe that the provincial fairs, properly managed, are well worth all that they cost. They serve to develop a spirit of good feeling and of coöperative effort, they encourage competition, and they are a decided stimulus to various lines of industry. It is probable, however, that a great deal can be done to develop and improve the fairs that are now being held.

At the present time there is altogether too much diversification of interests in our provincial "fiestas." An athletic meet in one locality is followed by a corn demonstration at some other place with possibly a live-stock show in an adjoining province. It should be possible, at least in some instances, to effect a combination of these several features in one fair of sufficient magnitude to attract substantial support from different Government bureaus and from commercial houses in Manila. Such support would tend to reduce the cost of carrying on the fairs and would largely increase their value as educational and industrial enterprises.

There are certain features of any fair or exposition, the satisfactory arrangement of which is often a matter of some difficulty.

We refer particularly to the classification of live stock and of agricultural exhibits, and to the judging of such exhibits. In its connection with various fairs in different parts of the Islands the Bureau of Agriculture has had occasion to give considerable attention both to the question of classifying as well as to that of judging live stock and agricultural products. In all cases where the promoters of provincial fairs will communicate with the Bureau of Agriculture, suggestions regarding suitable methods of classification will be gladly furnished, and ordinarily, employees of the Bureau can be detailed as judges.

It has been suggested that several adjoining provinces might well unite in holding an annual inter-provincial fair. If this were to be done it would be possible to hold larger and better fairs, and it would tend to develop a spirit of inter-provincial coöperation as well as that of friendly competition. There is ample evidence at hand as to what can be done in this direction in athletics; we believe that equally satisfactory results can be obtained along other lines.

If our provincial fairs are to become a permanent institution they must provide features which will attract all classes of people in the community and they must also show results of permanent value. A combination of athletic contests, a live-stock show, agricultural and industrial exhibits, and practical demonstrations should furnish a sufficiently varied and attractive programme, and one that will guarantee the general support of the people. If the fairs are well organized and properly managed they can hardly fail to be an important factor in the industrial development of the provinces in which they are held.

BUREAU OF AGRICULTURE CIRCULAR No. 19—MAIZE PESTS.

[Circular No. 19. Manila, P. I., January 24, 1913.]

MAIZE PESTS.

By C. R. Jones, *Entomologist.*

GENERAL STATEMENT.

The larvæ of three distinct species of the family Noctuidæ have thus far been found injurious to maize in the Philippines. Two attack the leaves only, and the other attacks the growing bud or tip. In no case have the outbreaks been reported until the damage had been done and the larvæ were ready to pupate. As a general thing, severe outbreaks are exceptional and occur only in abnormal seasons such as the one just past; however, more or less damage is done from year to year by these worms. The injury varies with the locality, although in many cases the young cornstalks are eaten down to the ground, necessitating the replanting of these fields. Local infestations are rather general, traces of these "worms" appearing in nearly all the fields of the section invaded. With regard to the Islands as a whole, a very general infestation seemed to be prevalent throughout the Visayan Islands in 1912, and this pest may be common in other parts of the Archipelago, although reports to this effect have not been received by the Bureau of Agriculture.

LIFE HISTORY.

The adults of the maize "worms" are small dark or brown moths and belong to the *Lepidoptera,* family Noctuidæ. They are not seen during the daytime as they hide under blades of grass and in other secluded places. At night they feed and deposit their eggs on blades of grass and maize. The eggs hatch in the course of three to five days and the tiny larvæ begin feeding upon the leaves. The small size and the color of these newly hatched larvæ make them inconspicuous and the injury done by them is slight. As they develop in size, consuming in many cases the entire plant, they are noticeable; and as the food supply becomes exhausted they crawl about in search of new feeding grounds. The leaf-eating class (*Prodenia litteralis* Hamps., and

Spodoptera mauritia Boisd.) are of a black color. The budworm (*Chlorida obsoleta* Hubr.) is entirely green. When full grown the larvæ, measuring about 2 centimeters in length, leave the plant and enter the ground close to the stalk, form a small earthen cell, and in a short time pupate. The pupa is a slender reddish chrysalid from which the adult or moth emerges a few days later.

INJURY.

It is impossible to definitely state the amount of damage that will be done by these insects as this varies from a slight defoliation to a complete destruction of entire fields. The extent of the injury depends upon the age of the maize attacked and the seriousness of the outbreak. Climatic conditions must also be taken into consideration. Large plants resist the attacks better than smaller ones and new leaves are more promptly formed; although they apparently recover quickly, defoliation retards the growth of the stalks and is thus detrimental to the formation of the grain. From this it will be seen that these caterpillars, besides completely destroying young plants, which necessitates replanting, also diminish the yield of grain; thus control of the pests is highly desirable.

CONTROL.

The most satisfactory means of controlling these pests is by the use of arsenical poisons. Of these arsenate of lead and Paris green will give the best results. In fields where these poisons are used care must be taken not to let carabaos or horses graze, as there would be great danger of poisoning them.

The poisons may be applied in either dry or liquid forms. Dry applications are better as the only apparatus needed is a cloth bag, which is used as a receptacle for the poison. Liquid application necessitates spraying apparatus to be effective. Arsenate of lead is preferable to Paris green as the latter when applied in excess has a tendency to burn and destroy the plants; the former has no burning qualities and the plants may be covered with it without fear of injury.

These poisons should never be applied at a concentrated strength but should be reduced by mixing with four or five times their weight of flour or air-slacked lime. This will reduce the cost of the applications and be just as effective.

By means of a stick with a bag on either end (fig. 1) one may effectively apply the poison to two rows at once by simply jarring the stick when the bags containing the poison are over the plants.

As the caterpillars are general feeders and are found extensively upon grass around the edges of the fields, it is a good plan to apply the poison to these places, but this grass must not, after poisoning, be used as feed for animals.

Another good method in the application of these poisons is to mix 50 pounds tikitiki (rice bran) with 1 pound of the poison. This mixture, if dropped on the ground around the plants, will be eaten by the larvæ and will result in their destruction. By mixing burned sugar and water with this poison bait its effectiveness will be increased and the larvæ will be attracted from considerable distances.



Fig. 1. Method of applying poison to maize for maize "worms".

Paris green is preferable to arsenate of lead in mixing a poison bait as by use of the latter the appearance of the mixture is not changed, while the former gives the mixture a greenish color and there is less danger of using the poisoned tikitiki for any other purpose than that for which it was prepared.

In the work in Cebu last June with the use of poisoned baited innumerable larvæ were destroyed; as high as twenty were found around one bait ball.

In this connection it may be stated that collecting the larvæ and carrying them off the field—a custom arising from a superstition as to the origin of these worms—is of very little benefit, as these pests gradually return to the corn fields if they do not find suitable food in the place to which they have been taken.

BUREAU OF AGRICULTURE CIRCULAR No. 20—THE MANGO BARK BORER.

[Circular No. 20.]

THE MANGO BARK BORER.

(*Plocæderus Ruficornis* Newm.)

By C. R. JONES, *Entomologist.*

During October, 1912, our attention was called to an insect attacking the mangos in the suburbs of Manila, and it was found that many of the finest specimens of these trees had already been killed and scores of others were dying from the attacks. This insect was identified as *Plocæderus ruficornis* Newm., a comparatively large Cerambycid beetle.

So far as we know there is no other insect capable of causing so much injury to the mango industry as this. Recent information indicates that the pest is not confined to Manila, having been reported from Baliuag, Bulacan; Pontevedra, Occidental Negros; San Pablo, Laguna; and Lamao, Bataan.

Unfortunately it is difficult to note the attack of the insect until the tree has begun to show serious signs of infestation, such as the slight raising of the bark on the injured areas caused by the irregular tension over the larval burrows. On account of the first two stages of the insect being passed entirely beneath the bark of the trees, the first symptoms the casual observer may note are the dying of the branches on that side of the tree which has been attacked, or in case the entire circumference of the trunk has been infested, the gradual shedding of the leaves and finally the death of the tree itself. Though probably one year is required for the life cycle of this beetle, this apparent advantage to the tree owner is offset by the fact that the female beetle can fly several kilometers and may deposit the eggs in several or many trees, perhaps in as many barrios.

While the possibilities of injury resulting from this pest have been clearly demonstrated in and about Manila and while it appears there is no more serious menace to the mango industry in the Philippines at present, it is not the intention of this circular to arouse unnecessary alarm but merely to bring to

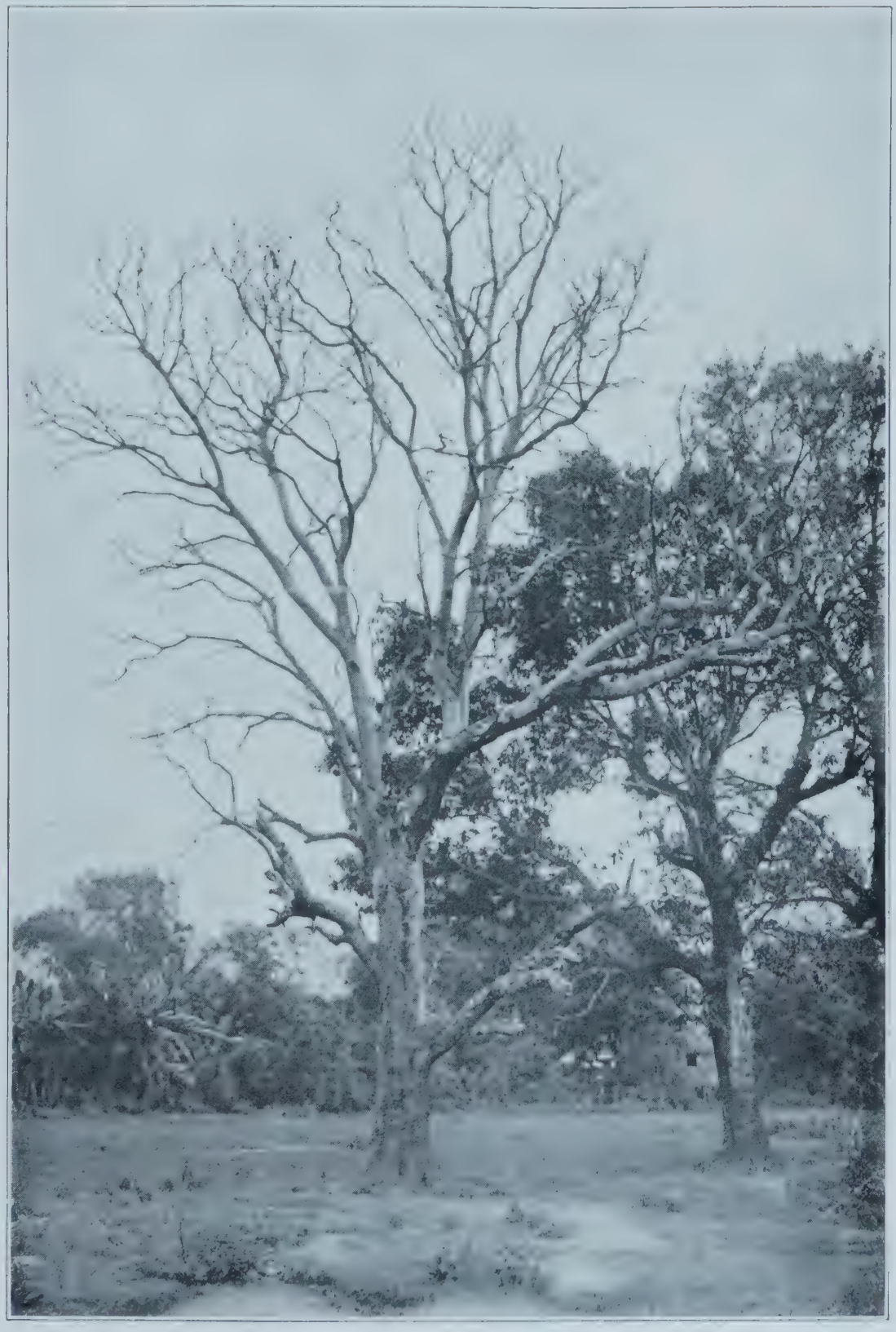


Typical appearance of mango trunk attacked by bark borer.



Mango trunk showing effect of bark borer.

Some of the larvæ have entered the wood to pupate; the pupal cases are in evidence in the burrows.



Mango tree killed by bark borer; Manila.

the attention of the owner of every mango tree here the importance of this pest and the means of its control.

METHOD OF ATTACK.

Observations in the vicinity of Manila indicate that the beetle prefers the larger mango trees. In fact no case has yet come to our notice where a tree of less than ten years of age has been found infested. The trunk and underside of the larger branches are the points usually attacked. Only when the tree has become severely weakened are the tops of the limbs invaded. The first attack is frequently made at the base of the trunk, the larvæ working their way slowly upward and subsequent broods of larvæ beginning their attack higher up the trunk or out on the large branches.

The deplorable custom of slashing the bark of the mango trunks in order to force them into fruiting is in part to blame for the injury, since the older bark curling up slightly at the margin of these bolo, or cutlass, scars forms a very attractive place for the female to deposit her eggs and it is probable that in a very large percentage of the cases the first eggs have been laid in these old scars. Investigations show that only very seldom are adult insects found in the upper portion of the trunk and in the larger branches; it thus appears that the pest resorts to the latter portions of the tree only when the preferred areas at the base of the trunk have been more or less consumed by larvæ. Trees generally recover from the first attack since the bark is of sufficient thickness to allow the grubs to feed in it without seriously damaging the cambium layer and the young sapwood just beneath; when other attacks follow, however, the tree is frequently so weakened that its death results.

At first it was thought to be a hopeless task to determine any practical methods of control but by a careful study of the insect and its habits, the character of the injury, and the behavior of the tree under treatment indicate that the methods recommended in this circular will suffice to check, if not eradicate, the pest. The fact that a large number of the grubs are required to cause sufficient damage to result in the death of a large and vigorous mango tree is of special importance and the reduction of the number of these beetles below the killing point in any outbreak will render future damage comparatively slight. By a concerted action on the part of all mango-tree owners in the infested districts it is believed that this pest can be practi-

cally eradicated; on the other hand if the beetle is left to work its will without any attempt to reduce its numbers it follows that in the natural course of events the mango, one of the most important fruit trees of the Archipelago, may be practically wiped out.

LIFE HISTORY.

It appears that the eggs are deposited singly on the bark of, or inserted into crevices or wounds in, the base and lower part of the trunk. As soon as the young larva is hatched it begins to bore its way into the inner bark where in the soft layers of tissue lying between the sapwood and bark the entire grub stage is passed. Fig. 2, (*a*) and (*b*), shows the appearance of the full-grown larva. At first the presence of the young grubs can scarcely be detected from the outside since there is little or no frass extruded, but by carefully tapping with a bolo, or cutlass, over the infested area a more or less hollow sound will indicate the presence of the pest. Some larval chambers have been observed to cover an area of 40 centimeters long by 20 centimeters wide. Plate I indicates the appearance of the bark over an infested area.

When a supply of fresh bark is not at hand, as in areas previously infested, the grubs frequently feed upon the wood itself; the burrows in the wood are parallel with the bark except in the case of the pupal cavities which are usually at a considerable angle to the outer surface. Plate II shows the appearance of a very severely infested trunk from which the bark has largely been removed to show the burrows containing pupal cases in the wood. The larva is nearly white with the exception of the blackish head which is smaller than the following segment. The clypeus is brown and hairy. The mandibles are black and very strong, with the palpi light brown. The antennæ are pale with reddish brown tips. The body is cylindrical, translucent, and covered with minute red hairs except at the intersection of segments. Legs brownish red with claws light. Spiracles reddish brown, the first pair three to five times the size of the others. The very large, broad and flattened segment just behind the head is more or less hardened to form a shield-like organ; it is brownish red marked in three places on the back with a lighter color. The fourth to tenth segments bear protuberances amounting almost to tubercles and the arrangement of these gives those segments an angular or nearly square cross-section. The tenth and eleventh segments bear

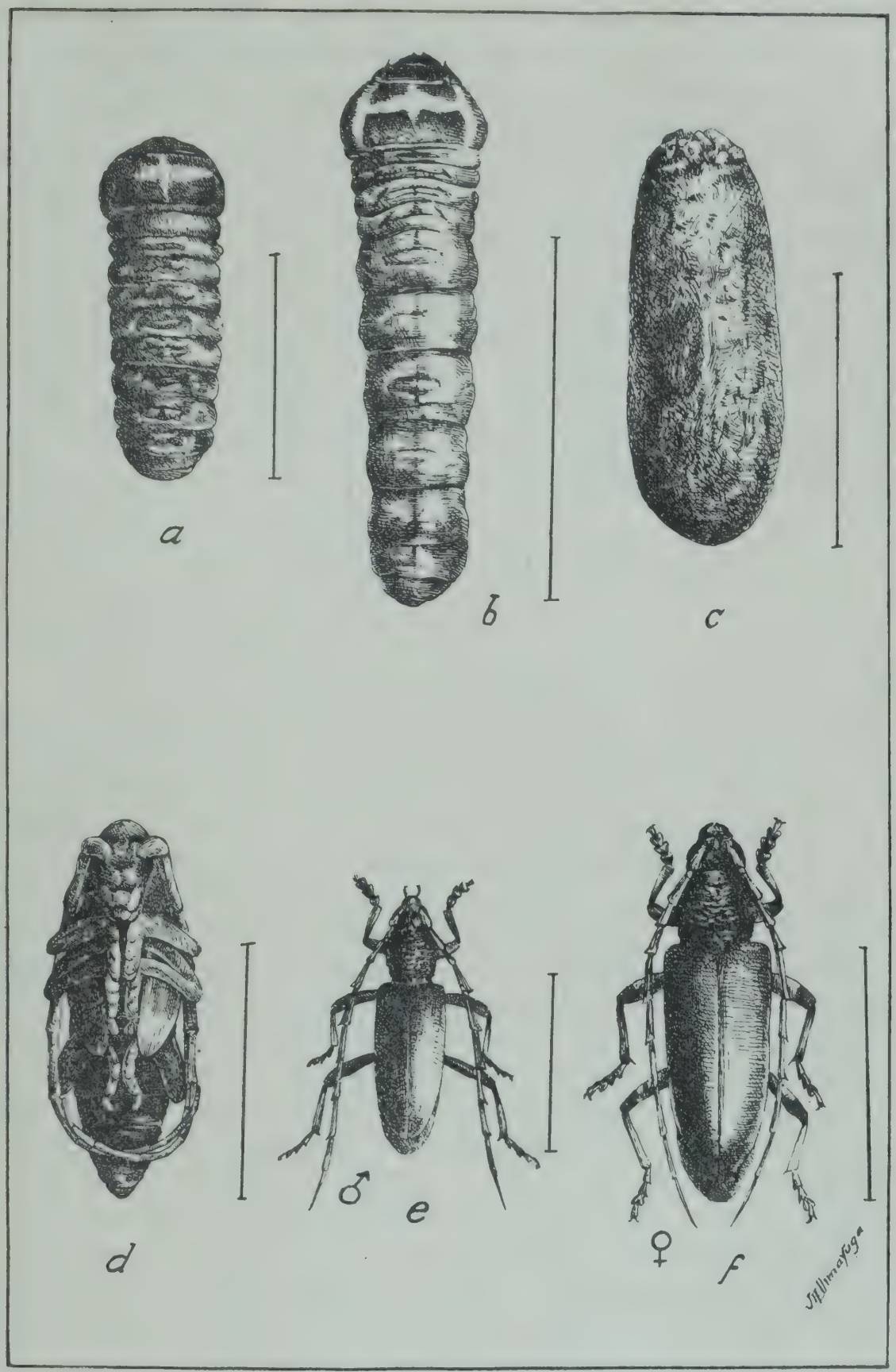


Fig 2. The mango bark borer (original).

(*a*) Larva (*Plocæderus ruficornis* Newm.) just after formation of pupal cell. (*b*) Larva (*P. ruficornis* Newm.). (*c*) Pupal cell (*P. ruficornis* Newm.) ; this is wholly composed of calcium carbonate. (*d*) Pupa (*P. ruficornis* Newm.). (*e*) Male adult (*P. ruficornis* Newm.). (*f*) Female adult (*P. ruficornis* Newm.).

folds of the integument of either side. One of the most characteristic facts in regard to the anatomy of this larva is the presence of two very long tubes lying just inside the skin and visible through the body wall; these tubes are at least four times the length of the body and doubled back at the head, they enter the alimentary canal about three-fourths its length from the head, but as the latter has one turn in it the ends of these tubes are very near the anal opening. From the general appearance of the location of these tubes, and the character of the surface of the roughened end of the pupal cell, it is highly probable that this solution is ejected through the anal opening itself. These appear to be homologous with the silk glands of the silk caterpillar but in the case of the insect in question they are filled with a condensed, flocculent, semi-solid secretion of carbonate of lime, which hardens in coming in contact with the air; from these tubes the larva constructs a highly distinctive pupal case which is in reality a marble cell.

At maturity the larva attains a length of 50 to 60 millimeters; the first body segment marks the greatest width; the head is only about 5 millimeters across.

When ready to pupate the larva forms a special cavity in the frass under the bark or in some cases eats into the wood itself. The calcium carbonate solution contained in the body tubes is now ejected to form a cell about the grub. As is common with similar larvæ, the body shortens considerably just before pupating, the length of this species in particular being reduced almost one-half. The cell (fig. 2 (*c*)) is strongly flattened and is more or less constricted about the middle; one end is larger than the other and the smaller is somewhat roughened. The thickness of this shell is from one-fifth to one-half of a millimeter. The following measurements based upon several hundred cells indicate the variation of the dimensions of this strange puparium which is nearly unique in the insect world as being composed entirely of mineral matter: Length 38 to 45 millimeters; width 16 to 18 millimeters; thickness 9 to 12 millimeters.

It is probable that quite a long time (say, one to three weeks) lapses after completion of the cell, before the pupa is formed, and also after becoming an adult considerable time is spent before the imago breaks through the shell. The pupa is about 35 millimeters long by 12 millimeters wide. At first it is of a semitransparent creamy white color but later certain portions of the body take on darker shades, the eyes becoming bluish black,

then the mandibles, palpi and legs turn brownish, and finally the wing cases take on the color of the adult.

The adult insect (fig. 2 (*e*) ♂, (*f*) ♀) is a rather conspicuous beetle from 23 to 45 centimeters in length with antennæ longer than the body. The body is a dull blackish color but the antennæ, as indicated by the specific name, are reddish brown. The thorax bears a strong sharp spine at each side and is minutely and irregularly corrugated on top; the legs are of the same rufous color as the antennæ with the exception of the joint between the femur and tibia which is blackish. The maxillary palpi are reddish but the mandibles are black. Like practically all the members of the Cerambycidæ this beetle stridulates when irritated or frightened. This habit is common to both sexes. The female is fully twice the size of the male but without other external anatomical differences.

The Tagalog name for this insect is "barbero."

METHODS OF CONTROL.

The principal difficulties encountered in the control of this pest are due to its habit of living beneath the bark which protects it against enemies during the larval period and also because of the parasite-proof pupa case. The insect being practically free from attacks by birds, lizards, or predaceous or parasitic insects, has an excellent chance of reaching maturity; in fact it would seem that every larva which succeeds in getting a burrow started under the bark is assured of maturity unless attacked by some fungus or bacterial disease. The only method of destruction therefore is a purely physical one. The necessary apparatus consists of a ladder, a rope, a spray pump, and a bolo or some other tool for removing the bark over the infested areas. The laborer simply cuts or pulls off the bark and removes all the frass, grubs, and pupa cases; a three-cornered hoe, or a short bolo blade fastened to the end of a bamboo pole may be used with excellent advantage especially on the branches and upper part of the trunk. After the burrows have all been cleaned out and the frass and decaying bark entirely removed, this area should be sprayed with a resin wash to prevent the entrance of fungi and wood-boring insects. For applying this protective solution an automatic spray pump should be used. A hand pump with a bucket will, of course, answer the purpose for ordinary cases but where large numbers of trees are to be

treated a knapsack or compressed-air pump should be used. The resin spray is, of course, not absolutely necessary.

The cost for treating large mango trees is calculated at 30 centavos per tree on a basis of 80 centavos per day per laborer. In the first experiments carried on by the Bureau in the suburbs of Manila, the city furnished six laborers for this work and 50 large trees in the districts of Singalong, Malate, and Paco were treated. Later the campaign was carried southward into Pasay and Parañaque. Trees that were treated in October have since been kept under close observation and in all cases they have shown indications that a complete recovery will ensue. Most of the trees responded very promptly to the treatment and are already growing new bark to cover the exposed areas. Even some of the trees that were practically girdled by the insects have recovered and are now blooming and bearing fruit.

It may be worthy of notice to mention the fact that the mere exposure of either the larva in its burrow or the pupa after removal from its cell is fatal. In fact it was found exceedingly difficult to keep larvæ alive after removal from their burrows during the rearing experiments at the Singalong experiment station. However, since there is some danger of a few stray live insects being left in the removed material, it is recommended that this *should be burned in a heap.*

SUMMARY.

The mango bark borer, while a comparatively unknown pest outside the vicinity of Manila, is exceedingly dangerous, largely on account of its feeding habits which make detection difficult. The beetle has, so far as we know, no natural enemies, being fully protected both in the larval and pupal stages. Physical remedies are, therefore, necessary, such as the removal of larvæ and pupæ from their burrows by hand.

Spraying the infested area of the trunk and limbs after thoroughly freeing them from the pest is recommended. Some spray which will not injure the tree itself but which will protect the exposed surface from fungi and insects that might attack the bare wood is recommended. The ordinary resin wash,[1] made by dissolving resin in an alkaline solution, is the best.

[1] See Bureau of Agriculture Circular No. 12.

THE SITUATION IN THE CITRUS DISTRICT OF BATANGAS.

By P. J. WESTER, *Horticulturist.*

Late in the year of 1911 the attention of this Bureau was called to the outbreak of a "blight" among the citrus trees in the citrus region of Batangas. Under instructions from the Director of Agriculture, the writer proceeded there November 9 and spent several days in the citrus district making observations which were submitted in a report the same year. The orange growers themselves, while aware of the condition of the trees, seemed rather apathetic in regard to seeking a cure at that time.

During the past year the trouble has become greatly aggravated, and, at the request of the Director of Education, the Director of Agriculture ordered the writer to again visit the citrus district in November, 1912. Altogether three separate trips were made in the investigation of the trouble and in securing typical photographs. On one of these trips made in November, 1912, the writer was accompanied by Mr. P. W. Graff, pathologist of the Bureau of Science. The writer wishes to acknowledge his indebtedness to Mr. George Whiting, supervising teacher, Santo Tomas, Batangas, for his assistance and aid which greatly facilitated the investigations.

The coconut, manufactured into copra and allied products for export, is, of course, preëminently the most important of the Philippine fruits, the banana is unquestionably the most important fruit supplementing the dietary of the Filipino, and the mandarin (*Citrus nobilis* Lour.), commonly called "naranjita," and the mango, furnish the most popular desert fruits in the Archipelago. The banana is the most universally planted, while the others are more or less localized. Trees of this species are, of course, found in most provinces, but, commercially speaking, practically the entire supply of mandarins comes from four towns in the Province of Batangas, Tanauan, Santo Tomas, San Jose, and Lipa—important in the production of mandarins in the order of their enumeration. By far most of the fruit is

grown in the district within the jurisdiction of Tanauan and Santo Tomas, extending eastward to Lake Taal.

Before the appearance of the coffee blight Lipa was the center of the Philippine coffee industry, and the spacious and solid houses and "camarines" seen here, many in ruins now, bear witness to the extent of the activity that once made the city a center of wealth and culture; even yet Lipa ranks as one of the most populous of the Philippine cities.

According to Mr. Whiting, who has compiled information relative to the industrial history of several towns in Batangas, Santo Tomas and Tanauan were once the center of wheat culture in the Philippines, and wheat continued to be the principal crop in the country adjacent to those towns until in the seventies, when a "blight" attacked the wheat, and, whether a disease or caused by insects, the trouble became so serious that wheat culture was abandoned, and all that remains is the ruins of the one time active flour mills. By the time this calamity struck Tanauan and Santo Tomas it had been noted that mandarins succeeded very well in the district, and in an attempt to build up another livelihood for the inhabitants an ordinance was passed by the Spanish government that required every landowner to plant yearly a certain number of mandarin trees. This ordinance remained in force for some years with the result that thousands of young trees were propagated and set out, and thus the "naranjita" groves of Batangas came into existence.

Mandarins are planted almost to the exclusion of the other species in the genus, though there are also a few oranges; the lime, calamondin, pomelo, cabuyao and lemon are very scarce; a few trees exist of a citrus fruit called "Tizon," which is presumably a natural hybrid between the orange and the mandarin.

The rearing of the plants and the culture of the trees subsequent to their planting in the orchard is simple in the extreme. Budding and grafting are known, but it is doubtful if many people realize the advantages of these operations, and excepting a few that have been imported there are no budded trees in the province. The plants are grown crowded in the nursery and transplanted into the orchard usually without any pruning of any sort and left to themselves. Rice, corn, and various vegetables are grown as subsidiary crops between the trees until they have attained their full growth, or the land is used as a pasture ground; after the year's crop from the "auxiliaries" has been gathered the weeds are usually allowed full sway until



Trunk of mandarin tree (*Citrus nobilis* Lour.) affected with barkrot, Santo Tomas, Batangas.



Same as Plate V, the flakes of dried bark having been brushed off exposing the sores made by barkrot.

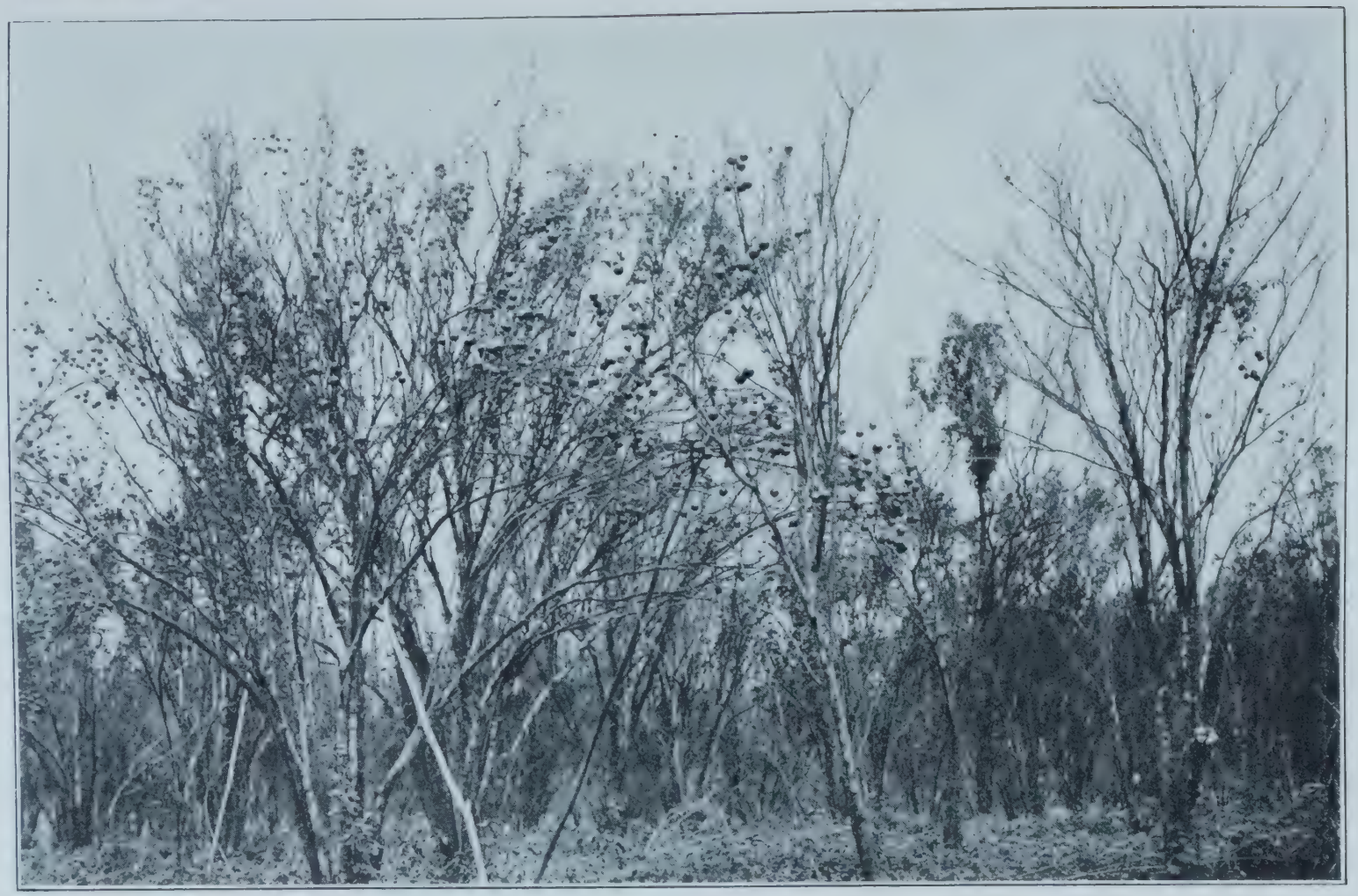


Portion of branch of orange tree (*Citrus aurantium* L.) attacked by barkrot, exposing scars after brushing off the dried bark, Santo Tomas, Batangas.



A typical young mandarin grove in Santo Tomas, Batangas.

Note the very unthrifty condition of the trees and the growth of weeds.



Dying mandarin grove; now a common sight in Santo Tomas and Tanauan, Batangas.

Photographed November, 1912.

the land is again planted. In the old groves the land is either allowed to grow up into weeds which are cut down once a year, in the dry season, or sometimes it is planted to "Madre de Cacao" (*Gliricida maculata*), which also is cut annually and the leaves and stems left for mulch. Little or no cultivation appears to be in vogue in a grove of fullgrown trees, excepting such as is given by the ever present "barrio" hog. No pruning worthy of the name is ever practiced and the dead wood in the trees is swarming with borers.

A number of scale insects are found but rarely in such numbers as to seriously impair the vitality of the trees. Here as in some parts of Florida and the West Indies, predaceous fungi and insects seem to have the scale situation well in hand in most instances. A species of *Loranthus* sometimes escapes from the forest and is parasitic on the citrus trees but in most cases it is held well in check. If allowed to gain a good foothold this plant works considerable injury to the hosts and finally kills them.

No one who was within range of vision or hearing is likely to forget the eruption of Taal Volcano January 29, 1911. This volcano is situated on an island in Lake Taal, a few miles to the east of the citrus district in Batangas. During the night of the eruption, which but for the rescuers would have anihilated all life on the island on which the volcano is located, the wind was in an easterly direction and mud and ashes were carried across the lake and deposited on the mainland. Near the lake this deposit was, according to Mr. Whiting, so heavy that many trees were more or less defoliated while farther east towards Mount Makiling the damage was trifling or none at all.

The severe drought during 1911, extending over a large area of the Philippines including Batangas, is also still fresh in the memory of all in the Islands.

Two such calamities, one following the other, would have exerted a malign influence upon trees in good condition and well cared for, and it is then only natural that under existing circumstances the shock received by the citrus trees in Batangas should be greatly accentuated. Also the presidente in Tanauan stated in November, 1911, that the year's crop was only 10 per cent of that of the year previous to the eruption of Taal, and a few of the old trees were then dead or sparsely foliaged, particularly near the lake. At that time quite a number of trees were in the active stages of barkrot, though taking everything into consideration, its attack seemed comparatively insignifi-

cant, the general unthrifty aspect of the trees being by far the most serious condition of the groves.

The following extracts from the writer's report of November, 1912, illustrate the situation in the citrus district as it stands to-day:

> The past summer with abundant rainfall has been a favorable one for the growth of the citrus trees. Nevertheless the general condition of the groves is decidedly worse than a year ago. A large number of trees are dead or beyond recovery that were in fairly good health a year ago and a large majority are in a poor and unthrifty condition. As is frequently usual under similar circumstances the trees during the current year bloomed and set a heavy crop of fruit which, of course, has served to devitalize the trees still further, and from all causes combined it is conservatively estimated that 50 per cent of the bearing trees in Tanauan and Santo Tomas are now beyond recovery.
>
> The entire absence of rational care of the trees coupled with the shock they received at the time of the eruption of Taal which was followed by an unusually dry summer is believed to be responsible for the premature death of a majority of the trees and the death of a very large number has been hastened by the outbreak of the disease already referred to in my last year's report. However, the disease at present is is not so prevalent as it has been for some months past as evidenced by the numerous scars of the affected trees that are now in the process of healing.

Very few cases of barkrot and those in a mild form, were found in Lipa; San Jose was not visited, no complaints having been received from this municipality.

The barkrot makes its appearance on the trunk and larger branches frequently 1.5 meters or more above the ground. The first indication of the presence of the malady is the oozing out of sap from the bark and the formation of a putrid sore at the point of attack, the bark and cambium layer decaying, giving off a fetid odor. The putrifying sap soon attracts a number of insects which feed upon the decaying matter and these are commonly believed by the people to be the primary cause of the sores, though it is very evident that they are of secondary importance. At most their presence is irritating and delays the healing of the sores. These are more or less irregular in outline and area, ranging from the size of a 10-centavo piece to sometimes, in very aggravated cases, girdling the entire trunk or branch; as the decay is arrested, in an attempt of the tree to overcome the disease, the sore dries up and new wood is formed around the edges; the bark also dries up and sloughs off. (Plates IV, V, and VI.)

The disease has much in common with the footrot that has been so destructive to citrus trees in many parts of the world,

yet it is quite distinct from that malady in that it extends from the ground well up into the tree, and also in the way it sheds the dead bark when the sores heal up; it also does not attack small trees, which are not exempt in an outbreak of footrot; and finally, the mandarin, which has been considered practically immune to footrot, is here attacked in common with the orange and calamondin. While in common with the gummosis it may be physiological in origin, it is distinct from this disease in not gumming.

Mr. Graff, who secured fresh material for study at the time of his visit, has thus far failed to find any indication of the presence of a fungus or bacterium that might be the cause of the disease.

Recommendations.—Neglect being unquestionably the principal cause of the death of the trees, better culture is the first and most essential step to take in the renovation of the groves and in the eradication of the disease prevalent there. The following suggestions are offered to the citrus growers:

1. All dead trees (including the larger roots, trunk and branches) and those beyond recovery should be removed from the grove and burned.

2. All dead wood and weak or dying growths should be carefully pruned out of the remaining trees and burned. The decayed areas of bark and wood should be cut out of those trees affected with barkrot and also burned, and the wounds lightly painted with a solution of crude carbolic acid and water mixed in equal parts (1 liter of water to 1 liter of carbolic acid). *Great care should be taken not to apply so much of this mixture that it runs down over the sound bark or to spread it over the sound portions of the tree for it is extremely poisonous and is deadly to all living plant tissues.* The above remedy has been applied successfully in the control of the footrot in Florida. The mixture is cheap and easily made and it is sure to destroy any fungi or bacteria which might be the cause of the trouble; should the malady be merely physiological, it can do no harm and it will keep away all injurious insects which might enter the wounds and irritate the growing tissues, and if applied properly, it is absolutely safe.

3. All weeds under the trees should be cut down and piled around the trees for mulch. Shrubs, etc., had best be removed and burned. The clearing of the ground should be followed by a shallow plowing of the land—*not too close to the trees* as the roots might be injured—just before the advent of the

rainy season, and the land planted to cowpeas or some other legume as a cover crop.

4. An application of a complete artificial fertilizer, 3 to 6 kilos to each bearing tree, according to size, would also aid in the recovery of the trees. This should *not* be applied near the large crown roots and the trunk, but be scattered thinly throughout the grove.

The purely cultural recommendations apply to all citrus trees in the region referred to, for there are exceedingly few that are in good and thrifty condition at present because of neglect and ill usage. It is safe to say that with the same lack of care that is accorded the citrus trees in Batangas, the citrus industry in Florida and California would be wiped out of existence in the course of a few years. Were it not for the soil and climatic conditions, which are exceedingly favorable for the development of the citrus trees in the region under consideration, there would be no citrus industry there. However, the patience of the trees and that of a kind Providence seem now to have become exhausted and the writer has no hesitation in saying that *unless the growers immediately take concerted action, abandon their slovenly ways of cultivation and apply modern methods in the care of their trees, it is a question of time only when the citrus industry of Batangas, like that of coffee and wheat, will be but a memory of the past.*

THE BATANGAS LIVE-STOCK SHOW.

By C. W. Edwards,
Acting Chief, Division of Animal Husbandry.

To the horticulturist the term Batangas signifies the famous green orange; to the agriculturist, the many varieties of upland rice; but to the lover of animals the term has, from early times, been almost symbolical of a horse, possessing certain qualities so superior to the average of other localities that it may be considered a specific type. It is true that this province at present can not boast of the numbers or the proportion of first class individuals, as was once the case, and of late there may have been a tendency on the part of some to question her vaunt of supremacy in horse production. However, a visit to the recent live-stock show held in Batangas the 16th, 17th, and 18th of January, 1913, would have convinced the most incredulous, leaving no doubt in the mind as to the correctness of this assertion. That the people are zealous in maintaining their reputation by continual improvement was forcibly evidenced by the thousands in daily attendance at this exposition, and in fact it is doubtful if the town of Batangas has in previous history ever witnessed as large a gathering.

The idea here followed of planning the opening date of the fair so as to occur simultaneously with the town "fiesta," or holiday, is a feature that might well be copied by the other provinces in the arrangement of subsequent events of this nature. In connection with each fiesta there are, aside from the primary religious features, always accessory amusements, provided by the cock-pit or other forms of diversion, that may well be substituted by features of educational and material benefit.

The entire number of officials who labored toward the successful accomplishment of this, the first live-stock show of the province, are deserving of only the highest praise. If there is one among this number, however, to whom credit is due over the others for the marked success of this venture, it is the acting provincial treasurer, Mr. E. T. St. Clair. With him the plan had its origin, and throughout the period of preparation

his untiring efforts furnished the impetus that kept the work in progress to final completion in every detail; his labors would have counted for naught, however, had he not received the hearty coöperation of provincial and municipal officials and the many other coadjutors who belong to a class of individuals who are not content with the performance of simply the absolutely necessary routine duties, but who are keenly interested in the progress of their province and put forth every effort looking toward advancement. Among these the provincial governor, the Honorable Pablo Borbon, is deserving of special mention for his active interest, enthusiasm, and efforts instrumental in the securing of the generous appropriation of ₱1,500 to be allotted as prize money to the winners in the various classes.

The most convincing proof of the meritorious work of the committee in charge of general arrangements and organization was the complete success of the fair. The members of this committee were the following:

The honorable the provincial board and Messrs. Belmonte, Tolentino, Sweet, Jose Villanueva, Felix Villanueva, and Rosales.

The details of classification and arrangement of entries was the work of Mr. Melecio Arceo and the several employees under his direction.

The walled courts adjoining the provincial building were admirably adapted as exposition grounds, and the temporary stables and other buildings for the various classes of live stock to be exhibited were constructed under the general supervision of district engineer J. W. Graham.

On the opening day, as the great crowd thronged into the city from every direction and the list of entries comprising the best of Batangas stock were checked up, the success of the first Batangas live-stock exhibit was no longer in question.

In the afternoon the preliminary trial heat in the running race was run over the two-thirds-kilometer course, which had been constructed on an open area to the north of the town, well adapted for this purpose. It is doubtful if the number and enthusiasm of the throng of spectators who witnessed this event has ever been equaled, even at the popular Manila speed park, "San Lazaro." The main preliminary race was won by a gray stallion, the property of the provincial governor. The races of this day as well as those of the two days following were held under the direction and supervision of the senior inspector of Constabulary, Major Sweet; Mr. Luna, the third

member of the provincial board, ably officiated as starter. The arrangement of classes and the successful manner in which they were conducted met with the hearty approval of participants and spectators alike.

The second day opened with a civic parade, under the direction of Rufino Canent, headed by the managing directors and the neatly uniformed Santa Rosa band, and followed by a company of Constabulary, while in the line were the gay turnouts of various officials and prominent individuals, the members of a number of local organizations, and the many choice animals of the exhibit.

In the afternoon occurred the second preliminary heat of the running race. The main event of the day at the course was the single harness trot or pace, in which a splendid iron-gray stallion owned by F. Martinez, of Balayan, was an easy first.

The forenoon of the concluding day witnessed the finals in the running races, and a very interesting $1\frac{1}{3}$ kilometer race of pacers and single footers under saddle.

In the afternoon, as a fitting climax to the exposition, the prize winners in the various classes were arrayed on the town plaza and the people gathered to hear the appropriate remarks of the provincial governor, and to witness his presentation of the prizes to the many successful contestants.

It might, perhaps, be possible to conduct a show of this nature in other localities in which the number of entries would exceed the number presented at this fair, but it is very doubtful if the average high excellence of individual entries could be surpassed or even equaled.

The class of pure native stallions was a particularly select lot. Every one of the eleven entries was a top-notcher and it was no easy task to choose the winner, but the laurels were finally bestowed upon a beautiful bay stallion with dark points, the property of Sixto Africa of Lipa. This section presented specimens of a class of horse embodying in a remarkable degree the qualities and characteristics typifying what is known as the "Batangas type," an animal of good size with plenty of width and depth of body, and showing remarkable style and action.

The class of pure native brood mares was first in number of entries, there being eighteen in all, representing nine municipalities. The trim, dark iron-gray mare owned by Miguel Lor-

zano of Lipa won the blue ribbon in this class, and a bay filly, the property of Pablo Dimaano, a close contestant for first honors, was placed second.

Perhaps the most interesting and instructive feature of the horse section was the large number of grade or so-called "mestizo" entries presented. With one or two exceptions these animals were the get of the Bureau of Agriculture sires, which have been stationed in the province from time to time. The results of early campaigns with these stallions have awakened the people to an appreciation of the value of this work, and within the past year a permanent breeding station has been established by the province near the town of Batangas where the Bureau of Agriculture now maintains one Thoroughbred, one Arabian and one mestizo stallion, and one Berkshire boar. The people are taking so deep an interest in these animals, and the demand for their services has been so heavy, that it is the intention to furnish them with additional stud stock in the near future. The permanent-station plan is a great improvement over the campaign method, as it allows opportunity for the proper care of the animals, suitable area for the growing of forage, and allows of the establishment of a paddock where the mares, which are brought for service, may be held for trial period.

Among the many mestizo entries, a majority were the get of the Thoroughbred stallion Handrail. This stallion, of Hannover stock, imported by the Bureau in 1904, has proved one of the most potent and satisfactory of the sires used in public breeding work. The prize winners in the mestizo mare and the mestizo stallion classes were both sired by this animal; the former, a beautiful, white-stocking bay, the property of Manuel Dimaano, of Lipa, although a little off in color, is a most excellent animal. The mestizo stallion, a superior first-cross type, the property of Mr. Felino Katigbac of Lipa, won his first blue ribbon at the Live-stock Exposition at Manila last year.

The most concrete object lesson of the horse division was furnished by an entry in the class of native mares with mestizo colts at side. In this particular case a promising Handrail colt, very pleasing in appearance, of only ten months of age, measured an inch more in height than his native dam.

The class of mestizo or native sires shown in harness brought out some very good material, the prize being awarded to a well matched team of bays of good performance, the property of Judge Mariano Cui.



(*a*) First prize, Class H, mestizo stallion.
Owner, Felino Katigbac, Lipa. Sire, "Handrail;" dam, native mare.



(*b*) Mestizo stallion.
First prize in Class E, "horses in single harness." Second prize in Class H, mestizo stallion
Owner, Bartolome Katigbac, Lipa.



(*c*) Dark iron-gray native mare, 52 inches.
Winner of first prize in native-mare class. Owner, Miguel Lorzano, Lipa.



(*a*) First prize, native bull, Class J.
Owner, Andres Moratilla, Taal.



(*b*) First prize, Class I, native cow and calf.
Twin calves in foreground, mother and full-grown male offspring. Owner, Vicente Amador, San Juan.

Although the cattle and carabao classes were not as well represented as were the horse classes, some very good individuals were shown. The winning entry under the class of native cows with suckling calf was a very good type of native dam with twin calves at side.

Among the classes of small animals some exceptionally good native sheep were shown, and a few pens of pure-bred poultry also warrant special mention.

The judging of classes took place in the forenoon of each of the three days of the exposition. The ribbons were placed by E. H. Koert and C. W. Edwards, of the Bureau of Agriculture, and Mr. Lemey, of the Quartermaster Department, Camp McGrath. The following is a list of classes with the respective prizes and winners in each class:

CLASS A.—Pure native brood mares:
First. Miguel Lorzano, Lipa ₱75
Second. Pablo Dimaano, Lipa 35
CLASS B.—Pure native mare with mestizo colt:
First. Juan Palacios, Batangas 75
Second. Julian Katigbac, Lipa 35
CLASS C.—Pure native stallions:
First. Sixto Africa, Lipa 100
Second. Victor Templo, Lipa 50
CLASS D.—Teams in harness, either pure native or mestizo:
First. Judge Mariano Cui, Batangas 150
CLASS E.—Horses in single harness, either pure or mestizo:
First. Bartolome Katigbac, Lipa 75
Second. Felino M. Katigbac, Lipa 35
CLASS F.—Saddle horses, either native or mestizo:
First. Julian Katigbac, Lipa 50
Second. Cipriano Africa, Lipa 25
CLASS G.—Mestizo mares:
First. Manuel Dimaano, Lipa 100
Second. Isabelo Joya, Batangas 50
CLASS H.—Mestizo stallions:
First. Felino M. Katigbac, Lipa 100
Second. Bartolome Katigbac, Lipa 50
CLASS I.—Native cow with calf:
First. Vicente Amador, San Juan 50
CLASS J.—Native bull:
First. Andres Moratilla, Taal 50
CLASS L.—Male carabao:
First. Evaristo Zuño, Rosario 40
CLASS M.—Pair of sheep, male and female:
First. Juan Palacios, Batangas 15
CLASS N.—Pair of goats, male and female:
First. Ciriaco Mendoza, Talisay 15

CLASS O.—Pair of hogs, male and female, native, mestizo or imported:
First. Martin Collazo, Batangas ₱30
CLASS P.—Pair of native chickens, cock and hen:
First. Roman Lacsamana, Batangas 10
CLASS Q.—Pair of imported chickens, cock and hen:
First. Lee Rogers, Batangas 10
CLASS R.—Pair of turkeys, tom and hen.
First. Juan Palacios, Batangas 15

The races were as follows:

CLASS I.—Free for all, running.
CLASS II.—Mounted, trotting or pacing.
CLASS III.—Trotting or pacing in single harness.

The winners were:

CLASS I:
Sr. Gregorio Aguirre, Batangas, first place ₱100
Sr. Benedicto de Villa, San Juan, second place 40
CLASS II:
Sr. F. Martinez of Balayan, first place 50
Sr. Benedicto de Villa, San Juan, second place 25
CLASS III:
Sr. F. Martinez, Balayan, first place 60
Sr. Benedicto de Villa, San Juan, second place 30

POPULARITY OF BANANA FOOD PRODUCTS.

By O. W. Barrett,
Chief, Division of Horticulture.

After a decade or more of partially successful experiments in the manufacture and popularization of banana products, a definite market is now assured, at least in Europe, and we may expect to hear of numerous factories being established throughout tropical America and, let us hope, even in the Philippines, within the next few years.

Jamaica in the West Indies has been the mother, so to speak, of this industry and it is in that island where nearly all of the really important factories for handling bananas are now to be found. In the March, 1912, number of The Philippine Agricultural Review attention was called to the appearance on the market of several varieties of banana products; it seems, however, that recently several additional companies have entered into the business in Jamaica. From the Daily Consular and Trade Reports we learn that at least six factories are now in operation and two other companies are contemplating the erection of large plants.

The following quotation taken from the above-mentioned publication indicates clearly the present status of the business; the processes in use in the various concerns are, of course, more or less private, though for that matter Philippine conditions would necessitate the working out of special methods for handling the material here:

> The original factory, which has been operating about six years at Gayle, claims to have a secret process for making banana figs. A large factory at Montego Bay had its machinery made after its own designs in New York. Two other companies expect to patent their machines, which have been locally designed and manufactured. It is understood that the drying is done by hot air and that it takes 400 to 500 pounds of fruit to make 100 pounds of the figs. For a good many years experiments have been made in drying bananas, but it has been difficult to find a process for making a product that would keep well. Now that manufacturers are using a variety of machines and apparatus it is to be expected that the best process will

soon be known. Although worms are never found in ripe bananas, the preserved fruit, if left exposed, attracts insects and soon becomes infested with small worms, as is the case also with other dried fruits.

The food products manufactured are fig bananas or banana figs, cooking bananas, banana chips, flour, and meal. All the factories dry or evaporate the bananas whole without the addition of sugar, and yet they are sweet and palatable, like pressed figs, which they also resemble in color. At least one factory cuts the bananas into short pieces before drying or evaporating them, thus making a product that looks much like the dried figs of commerce. It seems that it would be well in order to make a distinction to call the bananas cut into pieces "banana figs" and those treated whole "fig bananas." What are known as "cooking bananas" are so thoroughly dried as to be hard, the color of these being almost white. Broken into pieces they form "banana chips," which not meeting with duties are imported to be ground into meal or flour in the country of consumption. In spite of the fact that the meal is said not to keep well, one Jamaica factory uses an American gristmill for grinding the chips. Another company has its own factory in London, to which it exports the chips to be ground into flour and meal and made into other preparations for market. A small booklet is issued there to set forth the dietetic value of banana foods as attested by British and German food experts and others; and there is added a list of products on sale, with recipes for their use, etc. These banana food products have been awarded many prizes, diplomas, and certificates of merit.

It seems that all banana food products are wholesome and nutritious. The figs are delicious and are likely to be preferred to real figs by many persons. The fig bananas cut into small pieces may be used like raisins to impart an additional flavor to cakes and puddings. The chips, after being well pounded or ground in a coffee or other hand mill, may be boiled and then used as an excellent breakfast food or for making delicious puddings. Gruel, porridge, and other preparations made from banana flour and meal, which are rich in easily soluble carbohydrates, are recommended for infants, invalids, and dyspeptics. The negro women of Jamaica use banana meal gruel as a substitute for milk for their infant children. The banana itself is one of the most wholesome and nutritious of fruits if eaten slowly when it is perfectly ripe (that is, just before it decays), but not when devoured only half ripe, as is often the case in the United States, which causes many persons to regard bananas as being difficult to digest.

It seems only necessary to make the value of banana food products known in order to create a large market for them. Already they are to a considerable extent popular in Germany and Great Britain, which have been taking the bulk of the exports of such products from Jamaica. . . . The Hawaiian Islands and the Philippines also seem to offer inviting fields for the profitable manufacture and exportation of banana food products.

An interesting feature in the comparative progressiveness of Europe and America in the line of adopting new foods, etc., is brought out in the statement that a large United States order was recently refused by one of the Jamaica companies by reason that it was under contract for shipment to Europe of practically its entire output. It seems that the combined capacity of the

Jamaica factories is only some three tons per day but this will probably be considerably increased in the near future.

The writer remembers with pleasure testing both at Key West, Florida, and Washington, D. C., a series of samples of banana products made by a Central American firm; moreover, he made numerous experiments (extending even to table tests) at the Porto Rico Experiment Station in the line of flours, meals, and coffees, from numerous varieties of bananas and plantains grown in that island; in Porto Rico, however, the only form of banana food in general use aside from the fresh fruits is a plantain flour from which a most wholesome gruel for invalids is prepared.

In short, then, we should remember that banana products can be very cheaply grown in the Philippines; that these foods may be very conveniently and safely stored, transported, and exported; that they are of very high nutritive value; and therefore that they can not be overlooked in any study of the social economics of these Islands. In short, the banana as a crop not only helps out very materially the precarious old one-crop system but also provides a very interesting subject for study by the future manufacturers and merchants in the Orient.

THE CALTHROPS.

By P. J. WESTER, *Horticulturist.*

There are many interesting vegetables, fruits and nuts used for food or for other purposes in the Far East which are but little or not at all known in the Occident. Not the least interesting of these is the Calthrop, or Chinese water chestnut (*Trapa bicornis*), by the Chinese known as "ling" and "ling kok," and which is annually imported from China into the Philippines in large quantities during July, August, and September.

The Calthrop belongs to the family Onagraceæ and is indigenous to central China, where it grows wild in many localities; according to Mr. Amos P. Wilder, American consul general at Shanghai, it is most extensively cultivated in the Province of Kiangsi.

In China the Calthrop is grown in shallow lakes, ponds, and canals. The year-old nuts are "planted" in the spring, a meter or so apart, by dropping them into the water; they succeed best at a depth of about 1.5 to 1.8 meters. The nuts germinate rapidly and soon the plants appear above the surface of the water, much resembling a "field" of the water hyacinth. The nuts are harvested in boats late in summer.

The accompanying illustration (Plate XII) conveys the appearance of the Calthrop better than any written description. The average weight of a "nut" is 6 grams, of which 5 grams constitute the kernel. This is white and starchy and of a pleasant nutty flavor, and is eaten raw, boiled or roasted.

The Calthrop is closely related to the Singhara nut, *Trapa bispinosa,* which is extensively cultivated in Kashmir, the northwest and central provinces of India. In Kashmir the Singhara nut is said to furnish food for 30,000 people during five months of the year. The Singhara nut is grown on marshy inundated land. The seeds are sown in January by being thrown in the water and pressed into the mud with the feet or with sticks. In June, just before the rainy season, the plants are thinned and transplanted, and the "nuts" are harvested in November and December.

As far as known the cultivation of either of these plants has never been attempted in the Philippines.

CURRENT NOTES—MARCH.

NOTES BY C. R. JONES, Entomologist.

FRUIT-FLIES.

Several months ago fruit of *Eugenia malaccensis* Linn., obtained in the market, was found to be infested by dipterous larvæ, which at first were thought to be of the Mediterranean fruit-fly (*Ceratitis capitata* Wied.), but upon determination they were found to be of the mango fruit-fly (*Dacus ferrugineus* Fabr.). These flies are quite common through Java, India, Ceylon and Amboina, as well as the Philippines, and cause considerable damage to fruit. They do not confine themselves to any one class of fruit, but are particularly injurious to the mango and citrus fruits. Over fifty species of the genus *Dacus* have so far been described from Malaysia.

A late shipment of *Citrus hystrix* DC. from Bohol contained numerous dipterous larvæ which have not as yet emerged, but which are in all probability of the above species.

TOMATO-LEAF BEETLE.

In the numerous gardens throughout Manila considerable damage is being done by *Epilachna vigentioctopunctata* Fabr., this insect belonging to the family Coccinellidæ, many of which are beneficial insects. This pest injures the tomatoes by feeding, in both the adult and larval stages, upon the upper and lower epidermis of the leaf. Infested plants are readily recognized by the brownish color of the leaves which curl up and eventually die.

The eggs of this insect are deposited in groups containing from 9 to 40 each. Adults have been observed to oviposit from one to three clusters of eggs almost daily over a period of sixty-five days. Observations were made on numerous isolated pairs of these insects and the eggs laid were recorded. Two females which emerged February 6 were noted to oviposit during the period from March 6 to May 15; the total number of eggs laid by these two insects was nine hundred and sixty in forty clusters. From this we see the rapidity with which this insect increases,

and as the adults move about promiscuously, considerable damage can be done.

This pest may be controlled by a proper application of Paris green or arsenate of lead.

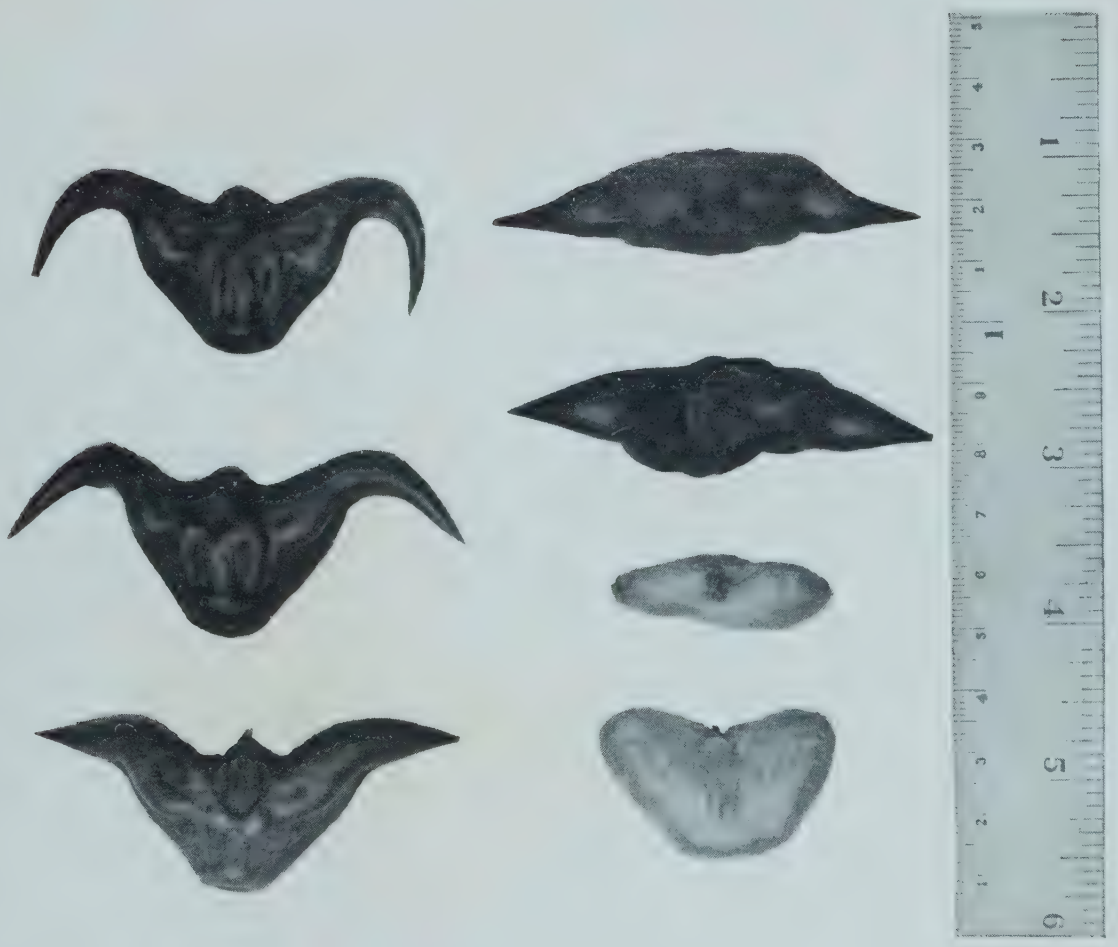
MAIZE STALK-BORER.

Considerable damage is being done to young maize by the maize stalk-borer, *Pyrausta vastatrix* Schultze. This insect belongs to the family Pyralidæ and injures the plant by boring into the stalk at the joints, where the insect spends both larval and pupal stages. As this pest feeds on the interior portion of the plant it is not amenable to insecticidal treatment such as would be effective for other insects, hence the only method of control would be by parasites, trap lights at night for the adults, or destruction of infested stalks. This pest so far has been reported only from Luzon.

LOCUST SITUATION IN THE VISAYAS.

Outbreaks of locusts in the Visayan Islands are now well under control. At present Iloilo has only three municipalities that have hoppers. Cebu, which up to January 1, had a total infestation, is now practically free from the pest. Reports from the assistant entomologist who is now in those Islands are very encouraging; he hopes that in another month Cebu will be free from locusts.

Bohol is doing good work, but the efforts of the Governor of Leyte deserve the greatest credit. A recent conference with Governor José M. Veloso revealed the fact that but two municipalities in this province are at present infested by "loctones" or hoppers. Instead of having the people work in mass as is customary with the pit method, he is requiring a certain quantity of loctones each day from each male adult in the province. This method has been carried on since December last, and has resulted in a nearly complete eradication of the pest in that province. Of the funds (₱5,500) alloted to Leyte, to date only ₱500 has been expended; the balance is still in the treasury of that province. The iron (400 sheets) shipped to that province is, all but 70 sheets, still available at the capital. The expenses of the campaign carried on in Leyte have been practically nothing as compared with those in the other provinces. Governor J. M. Veloso, says, "There is no need of heavy expenditures if the proper provincial officials go about the work in the right way. The requiring of every person to bring a certain amount of



Calthrops (*Trapa bispinosa*).

loctones to the municipal officers does not impose a hardship on the people in general and will soon eradicate the pest."

Reports from Occidental Negros show that the heaviest infestation is in the northern districts, the southern region being well under control.

NOTES BY P. J. WESTER, Horticulturist.

THE LEMON INDUSTRY IN ITALY.

Italy ranks first among the lemon-producing countries, and the tree grows there from Lombardy and Venetia in the north to Calabria and Sicily in the south. Sicily is the great center of the Italian lemon industry, seven-eighths of the 8 million lemon trees growing in Italy being planted in Sicily, or about fifteen times a greater number than is planted in California.

The "Agricultural News," which supplies the above information, also states that the average yield of a lemon tree in Sicily is 800 to 1,200 fruits; sometimes a tree will yield 2,000 fruits per year; also that the lemon crop of Sicily and Calabria was 6,900 million lemons, or 20 million boxes, each box containing from 300 to 360 fruits.

In Sicily lemons are planted from the coast up to an altitude of 435 meters. The trees are planted from 3.6 to 5.4 meters apart in the orchards. No frost protection is necessary in Sicily—although in Sorrento, on the coast of the gulf of Amalfi, the trees must be protected from the frost during the winter. The best lemons are produced on the rich soils in the hills. On the lighter soils the fruit ripens earlier but is poorer in quality.

The culls are utilized in making essential oil. In this operation the fruit is cut into halves, the pulp is removed, and the empty skins are soaked in water for four to five hours before the expression of the oil. Forty-five one-hundredths of a kilogram of oil is obtained from 1,600 to 2,200 half skins according to the quality and the ripeness of the fruit, green fruits yielding somewhat more oil than mature ones.

The production of lime and lemon juice in Sicily in 1911 was estimated at 4,800 tons, as compared with 6,300 tons in 1910, and 7,500 tons in 1909. This calculation is based upon the estimate that 162 liters of concentrated lemon juice is equivalent to 100 kilograms of citrate. It is stated that the world's annual average production of citrate of lime and concentrated juice is 7,200 tons, of which about five-sixths is produced in Sicily. The remainder is produced in the British West Indies, Mexico, and Central and South America.

THE SAPUCAIA NUT.

From time to time as the more or less unexplored parts of the Tropics and their products become better known, new sources of subsistence and industrial raw materials are disclosed. One of the "newest" nuts is the "Sapucaia" (*Lecythis zabucajo*), a large tree, native of Brazil, Guiana, and Venezuela, and related to the Brazil nut. Like the Brazil nuts, the Sapucaias are many in a fruit, contained in a large "shell." The Sapucaia is said to be more easily digested than the Brazil nut, however, and to be of better flavor, sweet, and partaking somewhat of the flavor of the almond. In South America an oil is expressed from the Sapucaia nut that is used as a food and also manufactured into soap. The Sapucaia is sometimes seen in the United States where it is known as the Paradise nut.

THE SUGAR INDUSTRY IN FORMOSA.

The Consular and Trade Reports contain an interesting article on the sugar industry in Formosa. The Japanese methods of reconstruction of the government and the rehabilitation of the industries in Formosa have been subjected to considerable criticism, but there can be little but praise for the results attained.

The first modern sugar mill was erected in Formosa in 1902 by Americans; to-day there are thirty-three up-to-date factories in operation with a crushing capacity of 24,000 tons of cane per day, capitalized at 83½ million pesos and with a paid up capital of ₱42,173,358.

For modern equipment the Formosan mills are unexcelled, and it is contended that the American-made mills are more complete and more economically arranged than those made in other countries.

The present high standing of the sugar industry in Formosa has been attained by governmental organization and coöperation through its creation of the sugar bureau. From a total of 48,671 tons of sugar in 1900, the production had risen in 1910 to 300,676 tons. With improved methods of culture the yield during the same period had increased from 11⅓ to 16 tons per acre.[1]

Most of the sugar is exported and refined in the country of its destination, Japan importing the bulk of the raw sugar. Only one refinery has so far been erected in Formosa—in Tainan, owned by the Ensuiko sugar company. The Taihoku Sugar

[1] One acre equals 0.4 hectare.

Company has recently filed application for the erection of a refinery in Taihoku, the capital of Formosa, and other companies may be expected to follow suit in the near future.

In connection with the above notes it may be of interest to know that in 1910 the average yield of sugar per acre was 4.4 tons in Hawaii, 4.3 tons in Java, 1.8 tons in Cuba, and 1.6 tons in Formosa. The cost of sugar manufacture per pound [1] in these countries was ₱0.0544 in Hawaii, ₱0.0322 in Java, ₱0.041 in Cuba, and ₱0.0342 in Formosa.

THE FRUIT EXPORTS OF PORTO RICO.

In the December, 1912, issue of the REVIEW mention was made of the progress of Porto Rico agriculturally. In this connection the following statistics culled from the Cuba Review should prove interesting to the fruit growers in the Philippines.

Exports to United States.

	1911	1912
Pomelos	₱619.396	₱1,049,952
Oranges	1,407,992	1,168,736
Lemons	4,644	6,262
Limes	3,924	1,920
Pineapples	1,281,426	1,367,602
Canned pineapples	299,488	317,342

How long will it be before the Philippines can make a similar showing in her fruit exports?

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

A NEW CATCH CROP.

There is considerable excitement in India and Ceylon over a new indigo and a new method of handling that crop. Of course, synthetic indigo nearly ruined the natural-indigo trade several years ago but with this much better yielding variety (*Indigofera arrecta*) from Java, and a much improved method of handling the raw product, invented by Baron Schrottky, there is excellent reason to believe that natural indigo will come back into favor and probably turn the tables on the synthetic article.

The new variety is said to produce green material at the rate of 50 tons per hectare per year. This crop will undoubtedly be grown on most of the rubber estates in Ceylon and the Malay States and is recommended as a catch or subsidiary crop for coconut plantations here in the Philippines. Not only is the

[1] One pound equals 0.45 kilograms.

plant an almost ideal soil-renovating crop, being of the legume family, but the profit from the green material itself when turned into indigo paste should be, according to recent estimates, as high as ₱500 per hectare—which is, of course, better even than the average coconut crop itself.

A NEW PLOW.

Orchardists and horticulturists in general have long been looking for a special plow adapted to small fields, orchards and plantations, where the heavy traction or cable plows are not serviceable. It now appears that there is an English patent out for a motor-propelled plow which will probably revolutionize many agrarian practices. This new motor plow is fitted with a 4-horsepower engine and cuts a furrow at the rate of about 5 kilometers per hour. The cost of fuel is a negligible quantity, being only some ₱1.50 per day—which of course leaves horse-plowing away behind. The plow itself weighs only a little over 300 kilos. A cultivator may be attached to the plow so that it can be used in orchards and small fields to excellent advantage.

A very interesting feature of the plow is that it is more or less automatic. Like some of the larger power plows it has a self-guiding apparatus so that after the first furrow is made the plow need only be started and it will automatically cut the next furrow. Theoretically then, if the field was a large circular one the farmer could make the first furrow on the motor, then get off and leave the plow to *finish the field itself*.

SILK INDUSTRY IN MADAGASCAR.

There seems to be a general revival of silk culture throughout the Tropics. Recently the Madagascar government has taken steps to encourage mulberry growing in that Island and the classification of cocoons is to be made a matter of government regulation. The writer has personal knowledge of the excellence of the silk fabrics made by the Madagascar natives. Some very fine specimens of "Malagasy" silks are obtainable in most of the East African ports. This silk seems to be the product of a local caterpillar, probably native to the Island.

CAVIAR.

Now that the United States is producing a very considerable part of the false caviar of the world (from some of the larger fish in the Mississippi River and from the salmon canneries of

the Pacific Coast), it is of interest to note that the true caviar of the Caspian district of Russia is threatened with a considerable decrease. It seems that there is a great deal of poaching and illegitimate handling of the sturgeon roe. This not only results in decreasing the number of mature fish but demoralizes the trade itself. The poaching is carried on according to the American consul at Odessa by "English" hooks. These are sunk deeply into the mud where the fish lie when not in condition for spawning and their capture under these conditions is, of course, highly reprehensible.

Two other fish, the Beluga and Severuga, beside the sturgeon, produce commercial caviar. The value of the caviar yield is now about 10 million pesos per annum. More than half of this vast amount is exported to Germany while nearly 150 tons, or about one-third, are exported from Astrakhan to the United States.

SUNFLOWER POTASH.

The south of Russia is noted as the great sunflower district of the world but only recently have the stalks, usually considered a useless by-product, been made to produce potash. The ashes of these stalks are rich in potassium salts and some 7,000 tons of this potash fertilizer are annually exported from the north Caucasus district. When we realize what an almost infinitesimal part of the weight of the plant is its ashes, we are forced to regard the sunflower crop of that district as something more than remarkable.

BRAZILIAN RUBBER.

The horrible revelations of abuses in the Amazon River forests have had several good effects already. One of these is the recent regulations decreed by the Brazilian Minister of Agriculture regarding the establishment of experimental farms in the rubber forest districts. Not only are agricultural colonies to be started around these experiment stations, but hospitals will be erected for the welfare of the laborers as well as the colonists and rubber-syndicate staffs themselves. There will also be food-producing "factories" and exhibitions of food crops and products.

A NEW STOCK FEED.

All the world has been watching Germany for the past half decade to see what will be the next great discovery in regard to the potato crop. That country has already done more for this

crop in an economico-technical way than probably all other countries combined. It has given the world cheap potato alcohol and several kinds of potato flour, and has possibly improved somewhat on the American methods for extracting potato starch. The latest innovation is cited by the *Frankfurter Zeitung* as a stock feed made by artificially drying potato tops. These are said to have about the same value as meadow hay and it is claimed that there are no harmful results to the domestic animals.

On account of the succulent nature of the tops special apparatus is, of course, necessary—and that is just where Germany, of course, excels. If this new scheme works out, it is expected that about one-fourth of the total crop can be dried for stock feed and this will mean some quarter of a million tons, worth at least 100 million pesos. The Philippine coconut planter must take cognizance of this since any article which affects the demand for poonac in Europe must, of course, affect the value of the Philippine coconut plantation.

BOOK REVIEW.

"THE FLORA OF MANILA."

By O. W. Barrett, *Chief, Division of Horticulture.*

To the individual interested in either the botany or horticulture of the environs of Manila, this excellent work, by E. D. Merrill, Botanist, Bureau of Science, meets the demand completely, accurately, and interestingly. There have been several well-meant attempts toward helping plant lovers to a better knowledge of ornamentals and economics as well as the best methods of getting the most good out of them here, but it was reserved for Mr. Merrill to really put down in black and white the whole *flora* side of the subject.

Not only does the work carry some 450 pages of botanical descriptions, but there is also an excellent key to the families so that an amateur can readily trace out the relationship and even the genus and species of all of the ordinary and most of the rare ornamentals to be found in any of the Manila gardens. Over 1,000 species of 591 genera and 136 families are described as occurring wild or cultivated in the 100 square kilometers included in the area in question; this is only about one-sixth of the total number of plant species in the Philippines, but it is far more than most people realize; in fact, it is a question whether any other city in the world could give so good a showing. There is also a glossary of all technical terms which might puzzle a beginner.

The only criticism which we might make regarding the appearance of the work is its lack of illustrations. It would hardly be possible, however, to draw the line at any moderate number of illustrations in such a work as this; there would be as much need, perhaps, for 300 illustrations as there would be for 30. Mr. Merrill has added a popular treatise on the plant and its parts for those who are not fully familiar with botanical anatomy and, not satisfied with this, he has given a chapter on the herbarium and the best methods of cheaply and easily making one. The nomenclature is standardized and while

some of the most radical of the modern taxonomists might take issue with the author as to the "code legitimacy" of some of the names which are still under question, the names given in this work are absolutely reliable. Even the author of each species has been punctiliously given, and synonyms, where necessary, are inserted.

In a word, this work (which may be obtained from the business manager of the *Philippine Journal of Science,* Manila, P. I., at ₱5 per copy) is indispensable to everyone who wishes to really know the plants of Manila.



Six-year-old abacá plants, Libuton variety, Daliao, Davao.

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CONTENTS.

	Page.
Editorial	155
Bureau of Agriculture Circular No. 21, Kapok Culture	157
The Renovation of the Abacá (Manila hemp) Industry	167
Maguey (cantala) and Sisal in the Philippines	183
Correct Terminology for the so-called Sisal Fibers of Commerce	189
Current Notes—April: Burí Raffia; Pacol Fiber; Abacá Situation in Northeastern Leyte; Philippine Sabutan Hats; New Light on the Nitrate Fields of Chile; Agricultural Development of Latin America; Stock Raising in British East Africa; Profits in Pineapples	192
Rinderpest Situation, March 1, 1913	199
Announcement: International Rubber and Allied Trades Exhibition and International Cotton, Fibers, Tropical Products, and Allied Trades Exhibition, London, June, 1914	202

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ILLUSTRATIONS.

PLATE I. Six-year-old abacá plants, Libuton variety ..... *Frontispiece.*

Facing page—

II. Five-year-old kapok trees 160
III. Kapok pods, showing wide variation in development 160
IV. A cluster of fully developed, but unripe, kapok pods 160
V. Eight-months-old abacá plant 168
VI. Field of old abacá 168
VII. (*a*) Extracting abacá. First process—inserting knife prior to separating the outer fibrous strip. (*b*) Extracting abacá. First process—actual separation of the outer fibrous strip 168
VIII. Stripping abacá 168
IX. Hanks of knotted abacá 168
X. Sisal (*Agave sisalana* Per.) plants 184
XI. Harvesting henequen (*Agave fourcroydes* Lem.) 184
XII. Cleaning maguey (cantala) by "retting" 184
XIII. Harvesting maguey (*Agave cantala* Rox.) 184

EDITORIAL.

THE PHILIPPINE FIBER INDUSTRY.

By the ASSISTANT TO THE DIRECTOR.

The Philippine fiber industry includes the production and preparation of a very large number of vegetable fibers. It is an industry that is carried on to a greater or less extent in every municipality and practically every barrio of the Islands. The fibers of the Philippines include our most important export product, other minor exports, and a great variety of materials that enter into the domestic economy of the people.

Abacá (Manila hemp), the most important fiber in the Philippine Islands, has for many years ranked first in our list of exports. For a number of years this one product comprised approximately two-thirds of the total export trade of the Islands. The increasing production of copra and sugar has reduced in some measure the relative importance of abacá, although this fiber still remains our leading export. With the new uses for abacá that are now being developed, and with the gradual improvement in the quality of this fiber that will be the natural result of better methods of cultivation and fiber extraction, there should be a steady increase both in the quantity and the value of our abacá exports.

The present condition of the abacá industry is not satisfactory. The Philippine planters, having had a monopoly in the production of this fiber, have failed to introduce improved methods either in working their plantations or in the preparation of the fiber for market. The results that must inevitably follow such practices are now in evidence. Many of the largest abacá plantations are in badly run-down condition and large quantities of inferior fiber are being produced.

There is, however, a very encouraging feature of the abacá situation, this feature being the present attitude of the planters. They are coming to realize the needs of the situation, and there is a strong demand for assistance in the work of introducing improvements. This demand will be met in the immediate future by the establishment of a coöperative demonstration station in the heart of the abacá-producing district of southern Luzon. Other stations will be started as rapidly as the necessary arrangements can be made. These demonstration stations serve as

headquarters for the demonstration of improved methods, and from the stations trained inspectors are sent out to assist and instruct the planters on their own farms.

The Philippine fiber second to abacá in commercial importance is maguey. Our maguey industry has suffered during the past few years from prevailing low prices, but is in a greatly improved condition at the present writing. The one most vital feature of this industry is the question of introducing modern fiber-cleaning machines. Such machines have been perfected and are available, but their profitable operation requires a larger supply of raw material than the individual Philippine maguey planter is in a position to supply. The situation is similar to that of the small sugar planters, where the establishment of "centrals" calls for coöperative effort. We have in the Philippine Islands large areas that are better suited for the cultivation of maguey than any other crop, and it is greatly to be desired that this industry be placed on a substantial basis by the introduction of the necessary fiber-cleaning machines.

Another fiber of increasing importance in these Islands is kapok, sometimes called "tree cotton." This fiber is coming into very general use as a material for filling cushions, mattresses, and other articles. The demand for kapok already exceeds the supply, prices are high, and this fiber has a most promising future. We find kapok trees scattered throughout the length and breadth of the Philippine Archipelago, and conditions are entirely suitable for their more general planting. A large part of the kapok now produced is wasted, but as the value of this product becomes better known it will be more generally utilized, and kapok trees will probably be planted to a considerable extent as a secondary crop.

There are many other local fibers that are largely used by the people of the Islands, and that are of some importance in our interisland trade. The development and improvement of abacá, maguey, and kapok should, however, receive first attention. Each of these industries has its own special features, but the general problem is the same for all. This problem is to definitely ascertain such improvements as it may be practicable for the Philippine farmer to introduce, and then to transmit this information to the farmers in such a way that it will be utilized.

The present number of the REVIEW covers in considerable detail the work of the fiber division of the Bureau of Agriculture and the present condition of the fiber industry. In a subsequent number the question of improving this industry by means of coöperative demonstration work will be considered.

BUREAU OF AGRICULTURE CIRCULAR No. 21—KAPOK CULTURE.

[Circular No. 21. Manila, February 25, 1913.]

KAPOK CULTURE.

By M. M. SALEEBY, *Chief, Fiber Division.*

INTRODUCTION.

The kapok tree is so widely distributed throughout the Philippine Islands that there is hardly an island or province where it can not be seen growing here and there in gardens, along the borders of fields, or along the sides of public highways. The floss, or fiber, produced in the pods is the principal product of the tree, and for centuries it has been used by the Filipinos for filling pillows, cushions, mattresses, and other similar articles. It is estimated that there are produced in the Philippines several hundred tons of floss of which a comparatively small part is used for domestic purposes, and practically the whole of the remainder is left unutilized. It is only since 1905 that an attempt has been made to export the floss from the Philippines and, even since then, the quantity exported is entirely too small in proportion to the amount produced.

It is believed that the present steady demand for kapok and its high price will render possible the collection and marketing of a large part, if not practically the whole, of the Philippine crop, at a reasonable profit to the producer. It has also been demonstrated in Java that the cultivation of kapok on a large scale for commercial purposes will give satisfactory results, considering the simplicity and the comparatively low expense of its cultivation. Furthermore, it appears that the admirable qualities of the floss for filling purposes have recently been fully recognized by the markets of the world, with the result that a strong demand for it has been created, which the supply so far has not been able to meet.

To acquaint the producers of kapok in the Philippines with the full merits of the floss and the importance of its production on a large scale for export, and to guide those whose interest in it

has already been awakened, is therefore the aim of this circular. For further information on the subject the reader is referred to Bureau of Agriculture Bulletin No. 26, entitled "The Kapok Industry."

CLIMATE.

The climatic conditions which directly affect the growth of the kapok tree and the development of its pods are three, namely, the degree of temperature, the amount of rainfall, and the frequency of strong winds.

The kapok tree requires a warm climate. For this reason its successful cultivation can only be accomplished in tropical and semitropical countries. For the same reason kapok should not be cultivated at an elevation above 500 meters, though it has been known to grow at as high an altitude as 1,200 to 1,500 meters.

Kapok does not require a large amount, nor an even distribution, of rainfall. It can withstand a comparatively long period of drought, and in fact this is essential during the period from the first appearance of the flowers until the pods have been harvested, which here in the Philippines usually covers the five months between February and June.

The long, heavy, and horizontal branches of the kapok tree may be seriously injured by strong winds. During typhoons it is not uncommon to see trees actually uprooted and others badly mutilated. This should emphasize the necessity of selecting locations outside the typhoon belt; if within it, they should be protected by windbreaks, either natural or otherwise.

SEED SELECTION.

The great majority of the kapok trees in the Philippines are propagated from cuttings. In the few that are propagated from seed there is not even the slightest regard for the selection of good seed from desirable trees. This accounts for the present lack of uniformity in the size, number, and development of the pods produced by the trees in general.

Seed for planting should be selected from kapok trees which are more than five years old, which are of rapid growth and of early and uniform fruiting habits, and which produce a large number of pods having a comparatively thin husk and containing a large quantity of floss of good quality. After selecting the tree or trees with due consideration to the above requisites, it will again be necessary to select only the desirable pods from each, since many pods will be found which are either too small, in-

completely developed, or which contain fuzzy floss of a natural dull color and seed far below the average size.

Plate III shows the wide variation in the size of pods which may occur in trees grown in the same locality and under the same conditions. Similar variation also occurs in the quantity and quality of the floss, and in the size and development of the seed; hence the importance of seed selection.

CULTIVATION.

After having indicated the importance of the requisite climatic conditions and of seed selection, the next points which should claim the attention of prospective kapok planters are the details of cultivation. This involves a knowledge of the following important matters: requirements as to soil, methods of propagation, planting and subsequent operation, and cultural methods.

Soil.—The kapok tree flourishes in a wider range of soils than most other tropical plants of economic importance. Volcanic loams and soils of alluvial formation are best adapted for kapok, for they afford a soft medium for the proper development of the root system, besides being generally well drained. In sandy loams, and in clay loams also, the kapok tree produces very satisfactory results, providing these loams are sufficiently deep and well drained. Soils of inferior fertility are generally considered unsuitable for planting kapok on a large scale, though fair crops are known to have been obtained in several instances.

Propagation.—Kapok is propagated from cuttings or from seed. The use of cuttings is by far the easier method and is, therefore, more commonly practised. Cuttings are usually obtained in various sizes ranging from one-half to 2 meters or more in length. The small cuttings should not be of the same season's growth, and they should be planted as soon after they are cut as possible. They should be planted from 30 to 50 centimeters deep, according to size, and preferably at the beginning of the wet season.

Propagation from seed is on the whole the better method. The seed is of rapid germination and the trees reproduced from seed are generally healthier, more productive, and more resistant to strong winds and attacks from white ants and other insect pests than those reproduced from cuttings. The seed should be planted at the beginning of the wet season in a nursery in hills about 15 centimeters apart. The nursery should be properly prepared and kept clean from weeds all the time. As soon as the seed germinates a shade should be constructed over the young

seedlings and this should not be removed until they have attained a height of 12 to 15 centimeters, which usually takes about twenty to twenty-five days from germination. At this stage the hills should be thinned leaving in each only the one plant which exhibits the best and most rapid growth. The seedlings are ready to be transplanted into the permanent field at the age of 10 or 12 months, or when they have attained a height of 80 centimeters or more. Sometimes the seedlings are left in the nursery until they are 18 to 24 months old but there is probably no advantage in this practice, as the larger the seedlings, the more difficult it usually becomes to transplant them without a high percentage of loss.

Planting.—As in the case of cuttings, the seedlings also should be planted out early in the rainy season. The precautions which are usually taken in transplanting seedlings of other trees and plants must be observed here. The roots must not be unnecessarily mutilated, and sufficient soil should be left on them. The holes should be dug large and deep enough so as to leave at least 15 centimeters of fine soil under and around the roots. Before transplanting it is essential to cut off all the leaves; and if the seedlings are more than 50 centimeters but less than $1\frac{1}{2}$ meters high the stem should be cut back to the former height. If they are more than $1\frac{1}{2}$ meters, then they should be cut back to about 1 meter from the ground. The soil immediately around the young plants should be kept loose and clean from weeds, especially during the first six or eight months.

If kapok is intended to be the only or principal crop, the trees should be planted in straight rows not less than 6 or $6\frac{1}{2}$ meters apart, with the same distance between the trees in the row. At a distance of 4 or $4\frac{1}{2}$ meters, which we often hear recommended, the branches of two adjacent trees overlap, and during strong winds they are usually badly mutilated and often die back about one-half to 1 meter. At a distance of 6 to $6\frac{1}{2}$ meters there will be about 280 to 240 trees to the hectare, respectively.

No plowing or periodical cultivation of the soil is required with kapok, unless some other secondary crop which requires such operations is raised between the rows. In so far as the kapok alone is concerned, it will be necessary to keep the soil in good condition only immediately around the plants. In the remaining spaces it is best, of course, to keep down all weeds, especially the indigenous ones with woody stems. As this operation in most cases entails too high an expense in proportion to the value of the kapok crop, it might best be accomplished



Five-year-old Kapok trees at the Lamao Experiment Station.



Kapok pods, showing wide variation in development.



A cluster of fully developed but unripe kapok pods.

by the planting of cover crops, preferably legumes of economic value, which will help to cover all, or a large part, of the cost of the upkeep of the plantation. The decided advantages accruing to other economic plants and trees from the use of leguminous cover crops are, of course, equally shared by the kapok tree.

Cultural methods.—The prevalent method of growing kapok trees in scattered localities and without any order or system can only be justified in those instances in which the product is required merely for domestic use. In Java this has been gradually giving way to the more popular method of growing kapok as a secondary crop with coffee, cacao, vanilla, pepper, maguey (cantala), sisal, and others. As a secondary crop, kapok appears to have given such unprecedented results that several attempts have recently been made to cultivate it as the main crop with such secondary crops as corn, peanuts, mongo, or some other similar annual crop. By both the above methods kapok will give satisfactory results, the choice of either one depending mostly on the nature of the soil.

As a rule, kapok should not be cultivated as a main crop on rich soils, as in these soils other more remunerative crops, such as abacá (Manila hemp), sugar, coconuts, cacao, etc., can be raised. If, however, on account of lack of either capital or labor, or both, the cultivation of any of the above principal crops can not be accomplished, the cultivation of kapok is then justified. In such instances, of course, a secondary crop in the form of corn, peanuts, mongo, beans, etc., will materially increase the revenue derived from the use of such land. By the cultivation of kapok on rich lands as a secondary crop with another of the above as the main crop, however, the best results are obtained.

In soils of medium fertility kapok can be raised as a secondary crop with coconuts, maguey, or sisal, or as a main crop with corn or with a leguminous crop of economic value.

HARVESTING.

The first crop is usually harvested from the trees between the third and fourth year when reproduced from seed, and a year or more earlier when reproduced from cuttings. The first two or three crops are of course small, the normal crops beginning from the sixth or seventh year on, and keep increasing from year to year until the limit is reached at the age of 30 or more years.

The harvest usually begins toward the middle or latter part of April and lasts until the beginning or end of July. If possible, the harvest should be completed before July, for then the rains, which cause considerable damage to the floss, are usually abundant and more frequent.

To know when the pods are sufficiently ripe is perhaps the first and most important step in harvesting. Before ripening, the pods have a light-green color and a smooth surface (Plate IV). As soon as they ripen they turn light brown and the surface becomes somewhat wrinkled (Plate III). At this stage the pods should be harvested, for if left longer they always open at the top and the floss becomes exposed to rain and dust or other impurities which impair its quality. The pods should also be harvested during dry weather so as to prevent fermentation while they are stored prior to the separation of the floss.

After it has been gathered, the fruit should be sorted and then opened as soon afterwards as practicable. The sorting is necessary as some pods will be found bruised or otherwise damaged, while others will be found to show signs of incomplete or premature development. The longer the floss remains in the pod the more it depreciates in color and luster, and therefore storing should not last longer than is absolutely necessary. If during harvesting, or soon after, the pods become unavoidably exposed to rain or moisture, or if it becomes necessary to harvest them before they are sufficiently dried on the trees, then they should be opened immediately and spread on a clean floor, instead of being stored. Care must be taken, however, that such floss be not mixed with that from the dry and ripe pods.

CLEANING THE FLOSS.

Hand methods.—The bulk of the kapok produced is still being prepared by hand apparatus, which are simple in construction and crude in operation. The simplest of these, which is the first improvement over the handpicking method, consists of a bamboo frame set over a box or over the floor and so constructed as to have square holes large enough for the seeds to fall through. The floss and seed are put on the frame and beaten by bamboo forks or sticks until all the seeds have dropped through the holes, when the clean floss is removed and the operation repeated with another lot.

In the most recent hand method, which is probably an improvement over the preceding one, the floss as it comes out of

the pods is put in a bamboo basket or in a hollow cylinder with a perforated base. Through this is put a stick or piston to the lower end of which are nailed two pieces of wood forming a cross. The top of the basket or cylinder is covered, and by connecting the top of the piston with the necessary wheels and a handle the piston is made to revolve inside the cylinder or basket. The cross at the end of the piston stirs the kapok and the seed is separated and falls through the perforation at the base.

These crude native apparatus can only be used to advantage where labor is cheap and where kapok is produced on a comparatively small scale. In the production of kapok on a large scale, the use of modern and more economic machinery is indispensable.

Machines.—The invention and use of kapok-cleaning machines is one of the most vital factors affecting the present and the future development of the kapok industry. Without the use of such machines the cultivation of kapok will not be taken up by the more progressive class, but will be restricted to the poorer class of producers, as has been the case. Without machines, also, the industry can not develop to the extent warranted by the superior qualities of the floss and its suitability for numerous important uses.

The machines thus far constructed perform their functions on very much the same principles, as all or most of them have been based on the more improved hand process of cleaning the floss. These machines are, as a rule, simple both in construction and operation, strong, cheap, and portable, thus affording an opportunity for all classes of kapok producers to use them to advantage, providing sufficient trees are grown in close proximity to render their use practicable. For further information regarding kapok machinery the reader is referred to Bureau of Agriculture Bulletin No. 26, entitled "The Kapok Industry."

YIELD.

From several observations made by different persons in different localities it appears that an estimate of the annual yield of clean kapok from a tree of normal growth and under 7 years of age may be placed at 350 to 400 pods. Trees between 7 and 10 years should yield an average of 600 pods or more.

A very wide divergence is also encountered in the yield of floss by pods. While in some cases about 150 pods will yield

1 kilo of clean kapok, in others it may take as many as 300 to yield the same quantity. In this respect it is probably safe to calculate on 230 pods to produce 1 kilo. The judicious selection of seed for planting will undoubtedly increase the average yield of floss in the pods.

On the above basis a hectare planted in kapok, and containing 280 trees from 5 to 7 years of age, ought to bear 95,000 to 100,000 pods, which, at the rate of 230 pods to the kilo, will yield 410 to 480 kilos of clean kapok per year. From the seventh to the tenth year, a hectare should yield about 640 kilos.

In a general way it may be said that the yield of seed is double that of the floss. That is, a tree which generally yields 3 kilos of clean kapok during the year, yields also about 6 kilos of seed. Various tests have shown that the weight of clean kapok varies from 55 to 65 per cent of the weight of the seed. The yield of seed is also variable both as regards the number and the size of the individual seeds.

VALUE.

During the decade from 1900 to 1910, the value of kapok advanced from 27 centavos per kilo in 1900 to about 80 centavos in 1907 for the highest grade. After the latter year the value declined to 64 centavos in 1909, but advanced again to 80 centavos in 1911. In 1912 the value continued to advance reaching its maximum of 90 centavos toward the latter part of the year. With the exception of the years 1908, 1909, and 1910, the rise in value has been gradual. This gradual rise in the value of kapok is accounted for by the continual increase in the uses made of it, which was in turn caused by a more general knowledge of its superior qualities and its suitability for several purposes heretofore unknown. The recent awakening of a general interest in the cultivation and production of kapok in many of the tropical countries where it was practically unknown is directly caused by this rise in its value. This has also made possible the systematic cultivation of the tree and the cleaning and marketing of its product by the use of proper and modern methods.

USES.

The principal use of the greater part of the kapok produced, however, is for filling pillows, cushions, mattresses, and other similar articles of upholstery. Next to this may be mentioned its comparatively recent use for filling buoyant cushions. Finally may be cited its most recent use for textile purposes.

For upholstery purposes kapok is preferred to all other filling fibers on account of its great capacity for filling and also its great elasticity. The latter is demonstrated by the fact that all cushions and mattresses that are filled with kapok will, after the pressure is taken away, resume their previous dimensions. In other words, kapok does not get matted with use, as is the case with all the other filling materials. Its great capacity for filling is shown by the fact that the weight of the quantity of kapok required to fill a certain mattress is considerably less than that of any other material used for the same purpose.

The use of kapok in buoyant cushions dates back to a very recent period, prior to which cork was almost exclusively used. Now the former is gradually replacing the latter, and it is only a matter of a few years when kapok will be used to a greater extent than cork for this purpose. This recent use made of kapok has increased the demand therefor and manufacturers of articles of upholstery have already begun to complain of the excessive price of the raw material.

About the use of kapok for textile purposes very little is as yet known beyond the fact that a certain process has been evolved by Professor Goldberg of Chemnitz, Germany, which is based entirely on a novel and somewhat complicated system of preliminary preparation and spinning. The floss is treated in such a way as to render it easily spinnable, notwithstanding its shortness and brittleness which until now have been considered unsurmountable obstacles. Just how much of a success this can be called, and to what particular textile use kapok yarn is adapted, can not at present be stated.

BY-PRODUCTS.

The most valuable product of the kapok tree is, of course, its floss. Next to this in value and importance is the seed, which has also become an article of trade.

In Europe, to which the seed is now shipped in large quantities from Java, and in smaller quantities from other countries, including the Philippines, the oil is used to a large extent in the manufacture of soap and as an adulterant with other oils; the residue, or cake, is probably largely used as cattle feed and as fertilizer.

The weight of the seed is, roughly speaking, double that of the floss, and its value in the Manila market at the present time is about $3\frac{1}{2}$ centavos per kilo. On this basis a hectare of

land planted to kapok under 7 years of age will yield 800 to 900 kilos of seed [1] per year valued at ₱28 to ₱31.50. The wood of the kapok tree, which is light and soft, is used for tanning leather and for other minor purposes. The tree yields a dark-red, almost opaque, gum which has some medicinal value. The young leaves, when ground into a paste, are also used medicinally. The bark contains a reddish fiber which is sometimes used for tying purposes.

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[1] See page 164.

THE RENOVATION OF THE ABACÁ (MANILA HEMP) INDUSTRY.

By M. M. SALEEBY, *Chief, Fiber Division.*

In value and importance the abacá crop of the Philippine Islands is second only to rice. Its importance does not consist only in the millions of pesos that are annually sent here from the United States and Europe to purchase the fiber, but also in its value and usefulness for local manufactures and for the various important domestic uses for which it is employed. The present status of the abacá industry has recently been sufficiently dwelt upon in this REVIEW and in other publications of this Bureau, and it is an indisputable fact that the industry is in great need of renovation and reëstablishment on a more sound basis. This need has always existed, but it has recently been more strikingly presented to the attention of all parties interested in the welfare of the industry, as a result of the calamities which have recently come upon these Islands in the form of a prolonged drought and severe typhoons, which have emphasized the necessity of reform in certain phases of the industry.

The most important phases of the abacá industry upon the reform of which should be entirely based any attempt toward renovating it are the following: (1) The judicious selection of suitable sites for the plantations; (2) the practice of modern methods of culture; (3) the improvement of the quality of the fiber; and (4) the adjustment of the relations between the local buyers and the producers.

In the space here available, it is difficult to do justice to the above important problems, since each requires for its thorough discussion as much space as is here allowed for them collectively. However, if the writer succeeds in indicating the chief causes that have brought the industry down to its present condition and is able to suggest effective and practicable remedies for the same, he will have accomplished his earnest desire.

SELECTION OF SUITABLE SITES.

With abacá as with any other crop, the success will depend in a large measure on the suitability of the location of the plantation for that particular crop, both in regard to its soil and its climatic conditions. The soil and climatic requisites for the successful cultivation of the abacá plant are fully described in Farmers' Bulletin No. 12 (revised edition), and also in certain numbers of this REVIEW,[1] to which the reader is referred. At present it is sufficient to state that the soil should be of a high degree of fertility; the climatic conditions required are an even distribution of rainfall, with a high degree of precipitation; and the site should be free or protected from destructive winds. A large number of planters do not exercise sufficient judgment in selecting suitable sites for their plantations. In some of the principal abacá provinces it is often the custom to plant abacá or coconuts on the land which is not suitable for growing rice. In many instances, of course, the sites selected are wholly unsuitable for abacá. This lack of judgment attains its worst stage during the periods when the prices of the fiber are high. As long as high prices last, reasonable profits can be obtained even though the plants do not attain the extent of growth which they should attain. During dull periods, however, or even when conditions are normal, very little, if any, profits can be obtained from such plantings, and consequently the reputation of abacá is prejudiced in several ways: First, owing to the small size of the stalks on such land, the fiber is unusually short and the yield very low; second, the owners of such plantings are rarely in a position to market their product to the highest bidder, but they are, generally speaking, at the mercy of certain local buyers and must take what is offered for their fiber. This, as we shall see later, has been one of the chief causes for the production of inferior grades.

Summing up the situation from this point of view, it will be observed that the selection of unsuitable locations for abacá plantings has had a very undesirable influence on the industry in general, by causing an unhealthy increase in production which has afforded an opportunity for other fibers to compete somewhat seriously with abacá. By an unhealthy increase in production is meant that which is caused by an excessive proportion of low grade fiber and from which little or no profit is derived by the producer. At the time of the present writing the prices of

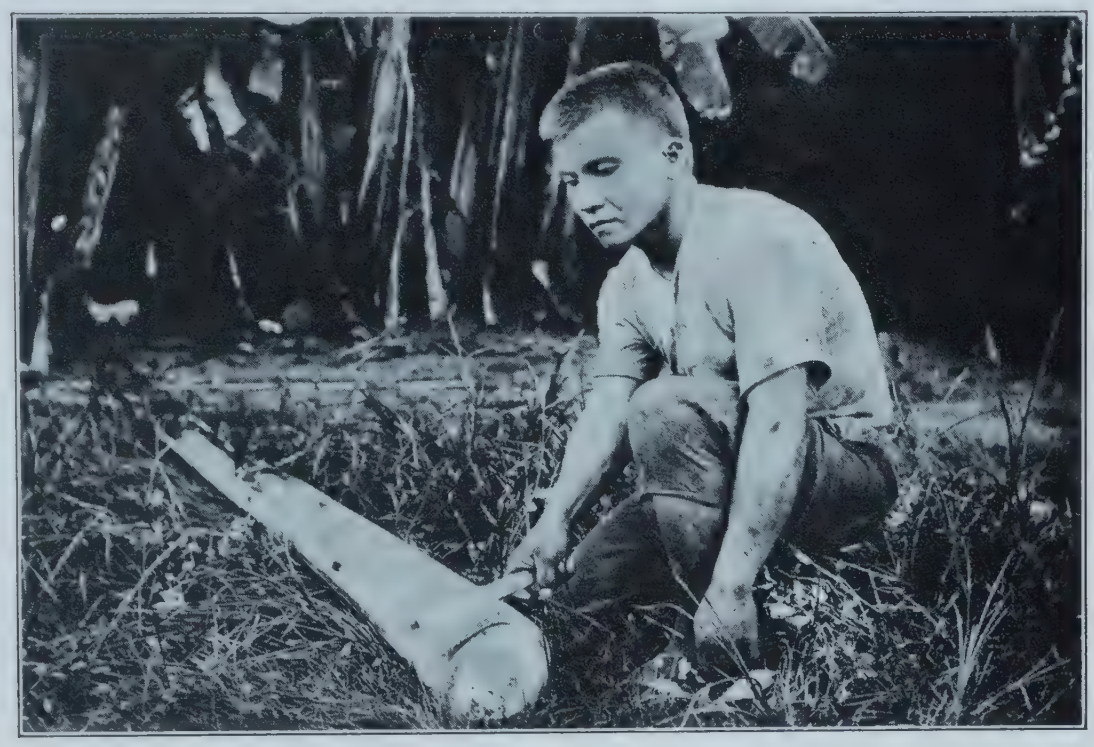
[1] Vol. IV, Nos. 6 and 12; Vol. V, No. 13.



Eight-months-old abacá plant at La Carlota Experiment Station. Cowpeas planted as a cover crop.



Field of old abacá.



(*a*) Extracting abacá (Manila hemp). First Process—inserting knife prior to separating the outer fibrous strip.



(*b*) Extracting abacá (Manila hemp). First process—actual separation of the outer fibrous strip.



Stripping abacá (Manila hemp).



Hanks of knotted abacá (Manila hemp).

abacá are abnormally high, and substantial profits are obtained from almost any kind of planting, although there is no assurance that these conditions will continue for a long period. It is hoped, therefore, that the abacá planters will learn from past experience and, as soon as prices are again normal, all the plantations which do not continue to yield reasonable profits or which can not be sufficiently improved by thorough cultivation will be planted to some other crop for which the soil and other conditions are more suitable than for abacá. Instances of this kind are numerous in almost every abacá-producing province, especially in the provinces of southern Luzon and in Leyte, where, if the practice here recommended is followed, it will afford a very strong impetus to the industry in general. Not only the owners of such lands profit by the change of crops, but also the rest of the abacá producers, as such a change will help to keep the market steady by reducing the large quantities of inferior fiber with which it is being flooded and in the production of which no one profits except, perhaps, the buyers.

CULTURAL METHODS.

Next to the elimination of the plantations that are unsuitable for the profitable production of abacá, the problem that should claim our attention is the reason why many plantations, which apparently meet with all the requisites for the successful cultivation of abacá, do not give more satisfactory results. This problem finds its solution in the inefficiency of the cultural methods which the majority of producers now practise.

Crude and antiquated methods have no place in modern agriculture. They had their day during the times when each country held a monopoly in one or more crops and did not have to face competition from outside either in the production of that particular crop or in that of substitutes therefor. That day is now over, and while in the production of abacá the Philippines practically still have a monopoly, other fibers which are used for many purposes for which abacá is used have already influenced the latter in more than one respect, and threaten a keener competition in the near future. In the face of such competition, therefore, the abacá producer can now hardly afford to remain passive and keep that secure attitude which he has so long enjoyed. He must discard the old and crude methods and adopt instead a better and more efficient system. It is only by this means that he may now and in the future hope to enjoy

the prosperity which his ancestors enjoyed and which he has recently been in danger of losing.

The most important cultural methods in which reform must be instituted before the desired progress can be attained are the following: Planting, cultivation, and the renewal of old plantations, which, on account of the important part they play in the renovation of the abacá industry, are hereby discussed separately.

1. PLANTING.

The two principal features that characterize the present prevalent method of planting are too close planting and lack of systematic planting. As a result of too close planting, the hills usually intermingle before they are 6 or 7 years old, due to the natural tendency of the abacá plants to spread out as they grow; and furthermore, planting at random prevents the practice of proper methods of cultivation, which are required during all stages of growth. It is not necessary to discuss here at length the details of the important steps of preparing the soil and planting, all of which have been covered in the several publications on the subject issued by this Bureau. The abacá planter should remember, however, that the plants should be set out in straight rows, not closer than $2\frac{3}{4}$ to 3 meters each way. Unless this is done, subsequent cultivation by proper and improved methods will be impossible.

2. CULTIVATION.

Cultivation in its widest significance comprises all operations connected with planting and the bestowing of attention, care, and labor upon the plants with a view of obtaining the maximum returns from them. Working the soil and weeding out all objectionable growth are, however, two of the principal operations that are included under cultivation, and these will form our chief topic of discussion at this point. The weeding out of objectionable growth can of course be effected by the planting of cover crops or by the use of cultivators or other tools, such as the hoe, bolo (cutlass), etc.

Ordinarily, it is almost impossible to use plows or cultivators either preliminary to planting abacá or during the first three years of its growth, on account of the large number of trees felled in clearing which cross the field in all directions. During this period, therefore, whatever cultivation is given the plants must be done by hoes or bolos, or in the form of cover crops

which usually remain until the abacá plants have completely shaded the ground.

Camote (*Ipomoea batatas*) is generally planted as a cover crop with young abacá. This serves the purpose in so far as it covers the soil and yields a useful food product, but it has been demonstrated that camote retards to a considerable extent the growth of the young plants. Leguminous crops, such as velvet beans, peanuts, cowpeas, etc., especially those of economic value, should be preferred to camote, for they grow quite as fast, cover the soil quite as completely, and, besides, enrich the soil with the much-desired element of nitrogen.

After the third year, when the plants will have become old enough for stripping, the question of cultivation resolves itself into regular and thorough weeding, with periodical working of the soil. The common method of weeding by bolos is neither economical nor efficient enough to justify its use. Even the use of the bolo is very sparingly practised by the majority of the growers, with the result that the abacá plantations in most instances have more the appearance of a semiforest growth. There is probably no crop of equal importance anywhere in the civilized world, which is as badly neglected as abacá is in the Philippine Islands.

With abacá the best results are obtained only by regular weeding, preferably by means of hoes, and the periodical use of modern cultivators. The advantages of the latter will be particularly shown during prolonged spells of dry weather, similar to the one that occurred last year. During last year's drought several reports were made by progressive planters to the effect that, had it not been for the use of cultivators, the damage would have been three or four times as serious. It may be of interest to mention here that most of these plantations have now resumed their normal condition of production, while the others, which were practically neglected during the same drought, will not recover completely until the end of this year or the beginning of the next, if indeed some of them ever recover at all. Last year's drought has also emphasized the necessity of irrigating abacá. Wherever possible, irrigation canals should be dug and provision made for periodical irrigation, whenever required.

3. RENEWAL OF OLD PLANTATIONS.

It is no exaggeration to state that not less than 75 per cent of the abacá plantations in Albay, Camarines, Sorsogon, Leyte, Samar, and other provinces where the cultivation of abacá has

been carried on for years, are too old, and the land and the plants are practically exhausted. This accounts for the very low yield from such plantations, which, on an average, hardly exceeds 400 kilos of fiber per hectare; a plantation of normal age and growth should yield on an average of 1,000 kilos per hectare. It is obvious, therefore, that the question of the renewal of old plantations and the knowledge of the methods used are, or should be, of paramount importance to the abacá planter.

The life of the abacá plant varies from twelve to twenty or more years, depending on the suitability and fertility of the soil and on the amount of care and cultivation given to the plant. Heavy soils, lack of cultivation, overcutting of stalks, and the frequent digging up of rootstocks or suckers all tend to shorten the life of the abacá plant. The majority of producers realize these facts, but by the methods now used in renewing old plantations they do not obtain the desired results. Their method consists merely in digging up shoots from the old plants and setting them out in the intermediate spaces. The plants thus reproduced are obviously neither so healthy nor so productive as the original ones.

The method that should be substituted for the above may be briefly described as follows: The old plants should be dug up, the soil plowed to a depth of 20 to 25 centimeters, and then a crop of beans, mongo, peanuts, or some other economic leguminous crop raised on it. After such a crop is harvested, what remains of it should be plowed under, and soon afterwards the abacá rootstocks or shoots should be planted in straight rows and at proper distances. As soon as the abacá plants have appeared above ground, a leguminous cover crop should be planted between the rows in order to keep the soil free from weeds until the plants have shaded the ground. Subsequent operations of cultivation should be restricted to the use of cultivators and hoes, which are far more effective and much less expensive than the use of the bolo. Thus, in the course of a few years, a new plantation with vigorous plants will stand on the site of the old one.

IMPROVEMENT OF THE QUALITY OF THE FIBER.

The abacá stalk is made up of overlapping leaf sheaths which are in reality prolongations of the petioles of the leaves. It is not, therefore, a stalk in the true sense of the word, though it is commonly referred to as such. This peculiar formation of the abacá stalk is responsible for the existence of five or six distinct

grades of the fiber, for the reason that the sheaths, from the outside ones to those near the core, differ perceptibly in thickness and color as well as in size and softness of the fiber contained therein. After every four or five sheaths we invariably find a noticeable change in the quality of the fiber. The distinct grades which are the natural outcome of the formation of the stalk may be designated as follows: Low, current, good current, good, and best, conforming to the five sets of distinct sheaths. These grades are obtained when machinery is used to extract the fiber, and also by the ordinary hand apparatus, providing it is so adjusted as to operate evenly and uniformly. Instead of these five grades, however, there now exist five groups each including three or more grades. This unfortunate increase in the number of abacá grades is due principally to the faulty method of extracting the fiber and the lack of care in handling it prior to and after extraction.

To show the extent to which the quality of abacá fiber can be improved, it would be necessary to give the relative quantity of each grade or group of grades when the fiber is carefully and uniformly extracted, and compare that with the same relative quantity when the fiber is prepared and placed on the market in the ordinary way. The several tests made at various times by the fiber office of the Bureau of Agriculture have demonstrated that the fiber carefully extracted from a certain number of stalks and graded in a uniform manner averaged approximately as follows:

Low grades [1]	per cent	5
Current grades [2]	do	10
Good current grades [3]	do	25
Good grades [4]	do	35
Best grades [5]	do	25

The above are average results of tests made with nine varieties of the abacá plant. No part of the fiber, with the exception of a few sheaths from one or two varieties, ever graded below superior seconds, and no unnecessary waste of fiber was caused. This last was proved by the percentage of fiber obtained from the green stalks, which ranged from 2.6 in the best varieties to 1.5 in the poorest ones, or an average percentage of 1.8.

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[1] From fair brown (red) to superior seconds inclusive.

[2] From current to midway inclusive.

[3] From 75 per cent over current to 25 per cent over good current.

[4] From 50 per cent to 150 per cent over good current.

[5] From 150 per cent to 300 per cent over good current.

It is difficult to estimate the present production of abacá by grades, and the proportion of the exports of each grade to the total. Droughts, typhoons, market conditions, and, to some extent, established custom of the producers in a certain province or district, all tend to cause a considerable variation in the relative proportion of the grades produced. The last is explained by the rather large differences in the quality of the fiber produced in the different provinces. It is roughly estimated that the Albay crop averages between good and superior seconds; the Camarines crop, fair or good seconds; the Sorsogon crop, about 25 per cent over current; the Leyte crop, current U. S.; the Samar crop, midway, or 75 per cent over current; the northern Mindanao crop, about current or 25 per cent over; and the southeastern Mindanao crop, good current or 50 per cent over.

The exports of abacá from the Philippine Islands are not tabulated according to grades and, therefore, the exact figures showing the proportion of the exports of each grade to the total are not available. A few of the principal exporting houses, however, keep a record of their exports for each grade, and it was through the courtesy of these firms that it has been possible to give the following approximate estimate of the exports of abacá by grades for the calendar years 1909 to 1912, inclusive:

Exports of abacá by grades (approximate) 1909–1912.

	1909		1910		1911		1912	
	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.
Best and good marks	2,623	1.65	2,625	1.50	9,875	6.25	6,020	[a]3.50
25 per cent over good current	21,147	13.30	7,087	4.05	5,609	3.55	5,160	3.00
Good current	9,381	5.90	9,188	5.25	9,954	6.30	10,148	5.90
75 per cent over current	13,118	8.25	10,937	6.25	12,008	7.60	14,620	8.50
Midway	12,879	8.10	17,412	9.95	15,010	9.50	18,232	10.60
25 per cent over current	24,327	15.30	32,200	18.40	19,750	12.50	21,500	12.50
Current	24,327	15.30	40,865	23.35	30,810	19.50	29,240	17.00
Superior seconds	16,695	10.50	15,137	8.65	16,590	10.50	29,584	17.20
Good seconds	13,674	8.60	15,837	9.05	17,064	10.80	15,480	9.00
Fair seconds	9,063	5.70	11,025	6.30	8,690	5.50	11,868	6.90
Good brown	5,724	3.60	6,650	3.80	6,478	4.10	3,440	2.00
Fair brown	3,339	2.10	4,200	2.40	3,634	2.30	4,816	2.80
Pacol, strings, etc	2,703	1.70	1,837	1.05	2,528	1.60	1,892	1.10
Totals	159,000	100	175,000	100	158,000	100	172,000	100

[a] Considering that the larger portion of the high-grade fiber has recently been largely handled by special firms other than the regular exporting houses, for export to Japan, Italy, France, Switzerland, and other European countries, where the fiber is used chiefly in the manufacture of hatbraids, certain kinds of laces, etc., the proportion of such fiber to the total can more correctly be estimated for 1912 at 10 instead of 3.5 per cent.

The average proportions of the exports of each of the principal groups of grades to the total exports for the last calendar year is, therefore, approximately as follows:

Best and good grades	per cent	10
Good current grades	do	18
Current grades	do	40
Low grades	do	32

A comparison of the above results with those given before clearly indicates the extent to which the quality of abacá may be improved by the practice of a more judicious method of extraction and by careful handling. It must be admitted, however, that for many reasons such progress is very difficult of accomplishment, though a considerable advance can, and should, be made. It should also be borne in mind that an improvement of the quality of the fiber must inevitably be accompanied by a decrease in production, due to an increase in the quantity of waste fiber when the higher grades are prepared in preference to the lower ones. The extent of the decrease in production will naturally depend on the grade prepared, and also on the skill of the men, the adjustment of the apparatus, and the variety and the degree of ripeness of the stalks.

Before proceeding to state how such an improvement can be brought about, and the extent to which it would be feasible to encourage it, it will be interesting to give a brief review of the principal uses for which the different grades of abacá are employed in the world's markets, as this bears directly on the problem in question.

The highest group, commonly known as "best marks," or "superior good current," consists of three grades, namely, 300, 250, and 200 per cent over good current. During the last three years, particularly last year, these grades have been in great demand by the cordage manufacturers, owing chiefly to the heavy purchases made by the Japanese and European manufacturers of hats and hat braids. The Japanese have been and are still buying chiefly the fiber, or raw material; while Italy, Switzerland, and France buy the fiber in knotted hanks or braids, manufactured locally, chiefly in the first-mentioned form. The rapid development of this recent hat-braid industry has reduced considerably the supply of the highest grades in the London and American fiber markets and has consequently stimulated a strong demand for them.

The next group, commonly known as "good marks," and also included in the term "superior current," consists of three grades, namely, 150, 100, and 50 per cent over good current. The fiber in this and the preceding group is far superior to all other cordage fibers, not only in strength but also in color and luster. It is mostly due to these grades that abacá has been given undisputed rank as the premier cordage fiber of commerce. The grades in this group are largely used for the manufacture of the higher grades of Manila rope, the lowest grade alone being sometimes used for making a special grade of binder twine. Generally speaking, the grades forming this and the preceding group meet with no competition from other sources, and the demand for them is almost always firm.

The third, or good current, group is here intended to include the three grades—25 per cent over good current, good current, and 75 per cent over current. These, it is understood, are generally used for making the good grades of Manila rope and also for the high grades of binder twine, but mostly for the former purpose. In these grades also abacá remains practically free from competition from other fibers, because of the decided superiority of its qualities to those of the other fibers used for the same purposes. The demand for these grades is also, on the whole, firm.

The fourth group, or current grades, includes midway, 25 per cent over current, and current. These are also mostly used for cordage purposes, though a much higher percentage of them than of the preceding groups is used for binder twine. The fiber in these grades is superior in strength to henequen, sisal, hemp, and the other cordage and binder-twine fibers, but in color it is inferior to these latter. It is in these grades that abacá begins to meet with competition, and the demand for it and its prices begin to be influenced to an appreciable extent by the other fibers. The competition is perhaps not so apparent in the midway grade, but it unquestionably is so in the current. The market quotations on the best grades of henequen and sisal are governed somewhat by that of current abacá, and are, as a rule, equal to the latter.

The lower grades of abacá include all those below current U. S. viz., current U. K., superior seconds, good seconds, fair seconds, good brown, and fair brown. These are principally used for the manufacture of the lower grades of cordage and the ordinary grades of binder twine, probably mostly for the latter use. The demand for these is governed to a considerable

extent by that for henequen, sisal, hemp, etc., most of which are decidedly superior to the former in either color or softness, or both.

Thus the grades making up the first, second, third, and part of the fourth groups have practically exclusive uses in which none of the rest of the cordage and binder-twine fibers can compete to any serious extent, except perhaps to a small extent as an adulterant with the lowest grade of the third group and the two highest grades of the fourth. This should indicate the necessity of producing on a larger scale the grades of the first three groups. The production of the lower grades at the expense of these would seem to be not only prejudicial to the interests of the producers, but also detrimental to the welfare of the industry in general. For it must be borne in mind that the cost of production of henequen and sisal, the two principal competitors of abacá below the grade of midway, is considerably less than the latter, owing to the use of machinery in their preparation and to their simple and inexpensive cultivation. Henequen and sisal, though they are not so strong as the lower grades of abacá, yet possess other characteristics, such as color and fineness, in which they are preferable to the latter, hence their recent use for many purposes for which the lower grades of abacá were formerly exclusively used.

There is undoubtedly a limit to the demand for abacá, which the production should not exceed. This limit varies somewhat every year, depending on the condition of the other fiber crops and on the general demand for binder twine and cordage. It is estimated that during normal years about 130,000 to 140,000 tons of abacá are needed by the world's fiber markets. This quantity is apportioned among the five groups of grades in proportions which the writer has never been able to ascertain, though, of course, this proportion is bound to be variable in response to the varying demands of the markets. Hence it is not possible at the present time to fix the extent to which the quality of abacá should be improved. That a considerable improvement over the present quality is urgently required, there is no doubt. Such an improvement will benefit not only the merchants but also the producers.

During 1912, the exports of abacá amounted to about 172,000 tons, of which about 10 per cent (17,200 tons) were of the two highest groups; about 18 per cent (or 31,000 tons), of the third, or good current, group; 40 per cent (or 68,800 tons), of the fourth, or current, group; and about 32 per cent (or

55,000 tons), of the fifth, or lower-grade, group. From market reports and correspondence with fiber manufacturers and local exporters, it is learned that the supply of good current and the higher grades was considerably below the demand for them. This was due partly to the insufficient production of these grades and partly to the rapid development of the abacá hat-braid industry which has taken away the larger portion of the highest grades. During this year (1913) the indications are that the demand for the high grades will exceed that of last year, while the total production of abacá is estimated to be about 135,000 tons, or 25 per cent less than last year. There is, however, a possibility of a larger decrease in production, but it is believed that the continuance of the prevalent high prices will increase the area harvested, especially in those provinces which were not seriously affected by last year's drought and typhoon, in which case the production will be as estimated above, if not a little higher.

In view of existing conditions it would seem safe to encourage the production of abacá of a higher average grade, until the entire production shall average in the third, or good current, group. In other words, the writer believes that during 1913 the best interests of the producers and a compliance with the requirements of the market will be obtained by the production of fiber which will average approximately as follows: 15 per cent, or 18,500 tons, of the first group; 15 per cent, or 18,500 tons, of the second group; 30 per cent, or 38,000 tons, of the third group; 30 per cent, or 38,000 tons, of the fourth group; and 10 per cent, or 12,000 tons, of the fifth group, out of an estimated total of 125,000 tons. This would be more than a halfway improvement toward the more or less theoretical standard given before, and would at the end of the year give a clearer conception as to what the future course of the producers should be. If at the end of the year the increase in the supply of higher grades has resulted in an increase in their consumption for the uses for which they are at present employed or for new uses, and the demand for them remains strong, then a further improvement can be recommended for future years. It is believed, however, that the production of the high grades at the above-mentioned rate will not lower the demand for them to any serious extent, and the producers can be assured of making higher profits in producing them than they are at present realizing on the lower grades. An examination of the local as well as the London and American market quotations on abacá during

the last few years, especially the latter part of last year, will leave no doubt as to the correctness of the above statement.

How can such an improvement in the quality of abacá be brought about? It is a well-known fact that the recent development and success of the henequen, sisal, and other fiber industries was brought about principally by the invention and general use of suitable machinery for extracting the fiber. There is, therefore, no question but that if similar machinery suitable for extracting abacá fiber becomes available, the industry in general will be improved, for such machinery not only raise the average grade of the fiber but will also bring about the much-desired uniformity in grade, by cutting out the several grades and shades of grades, the existence of which is entirely due to the unsystematic and antiquated method now in general use. Several attempts have been, and are still being, made, to invent suitable machines, but so far without any great degree of success. Until such machines are available, we must look somewhere else for the solution of the above problem.

ADJUSTMENT OF RELATIONS BETWEEN BUYERS AND PRODUCERS.

The writer believes that the strippers in the majority of the abacá provinces understand perfectly how to turn out the higher grades, and they can be made to do so providing sufficient inducement is given them. This fact resolves the solution of this problem to two factors: First, the adjustment of the relation between the local buyers, or middlemen, and the producers; and, second, the proper handling and just treatment of the laboring class, or strippers, by the producers or planters. Unless these relations are adjusted in a satisfactory manner it will be difficult to arrive at a satisfactory and permanent solution of this problem.

We do not have to go far to prove the validity of the above statements, for in the comparatively few localities where there is a progressive and independent class of producers the quality of the fiber produced is considerably higher than the average, the laborers are paid higher wages, the producers are more prosperous, and the industry in general is in a much more flourishing condition than in the localities where the producers are economically dependent on the local buyers. Generally speaking, the buyers do not sufficiently discriminate in prices between the high-grade and the low-grade fiber, and the producers are forced to accept the prices offered them by the former.

This state of affairs naturally leads the producers and the laborers to turn out the inferior grades, which is practically the only resort they have to protect their interests. This also explains the origin of the oft-quoted assertion to the effect that the producers realize higher profits in preparing the lower grades instead of the higher ones. The action of the producers under such circumstances as exist at present all over the abacá-producing provinces is easier to understand than that of the middlemen. Why the local buyers obstinately refuse to discriminate sufficiently in prices paid for the different grades is a question that is not so easy to answer. Perhaps one of the most characteristic examples of the conduct of middlemen is found in Albay Province, where it is reported on good authority that often there exists a difference of 5 to 6 pesos per 100 kilos between the price of a certain grade at Legaspi and at some of the towns in the same province. This difference is said to be even greater in the higher grades. All this will serve to show that the attitude of such middlemen must be actuated by one or more of the following reasons:

1. Most of the middlemen, being at the same time merchants, prefer to keep the poorer class of producers economically dependent upon them. This they are able to do by discouraging any attempt on the part of the latter to produce higher grades and realize larger profits.

2. In many cases the buyers do not themselves understand the differences between the various grades of fiber, and they feel safer in buying the lowest grades in which the differences are more apparent in quality and less so in price, than between the higher grades.

3. In many instances the local buyers calculate their profits at a certain amount per 100 kilos, as a result of a contract or some agreement with some other buyer. In such cases, it is obviously to the advantage of the buyers to purchase a low-grade fiber, for with a certain sum of money they can purchase more low-grade than high-grade fiber, and thus realize larger profits.

Thus not only the agricultural phase of the industry is in sore need of reform, but also the business phase of it. Indeed much of the success that it is hoped may be obtained in the reform of the agricultural methods now in vogue will to a large extent depend on the extent of the reform that can be effected in the adjustment and improvement of the relations between the buyers and producers. Hence this paper will be incomplete if it does not refer to the steps that must be taken to bring

about this latter reform. To describe in this paper the remedies for the present lamentable state of affairs with any detail is out of the question. The writer must therefore content himself with the following suggestions which will be intended to give an impetus in the right direction to any reform movement:

1. It will be necessary to enlighten the uneducated class of producers in regard to the principal grades of the fiber and the differences between them both in quality and price. In order to do so, it will be necessary, first, to establish standard grades which shall have uniform designation and which shall not be subject to change or modification; and, second, to classify such standard grades in groups, say, of three grades each such as is given in this paper, for the purpose of enabling the producer to determine for himself the group in which his product comes. This does not necessarily mean a reduction in the number of grades, but it does require a fixed and uniform standard. It may also be necessary to distribute samples of the grades throughout the principal abacá provinces, so as to have at least one complete set in every town of importance, and keep these sets in tight cases, renewing them at regular intervals, say once or twice a year.

2. The institution of planters' coöperative associations, which has recently been carried on in many countries to great advantage, could and should be carried out in the Philippines also. It is understood that such associations are established in Mexico for the purpose of regulating the supply of fiber in the market, as well as for maintaining a certain standard of quality. It is also learned that the various associations are represented by one central committee which not only arranges with certain banks to advance the producers a certain percentage of the value of their product until such time as the latter see fit to sell, but also studies the condition of the world's markets and keeps the producers advised as to the proper course they should follow. Such a system appears to have given excellent results in Mexico, and it is believed that some such system here in the Philippines would give similar results.

3. An educational campaign, accompanied by practical field demonstrations, similar to that organized by this Bureau in the Provinces of Cebu and Iloilo, would, it is strongly believed, give gratifying results. This Bureau is at the present time perfecting plans for such a campaign, and it is hoped that within a short time work will be started. The planters can, by taking sufficient interest in such work, derive a great benefit, especially

in matters pertaining to the most efficient methods of cultivation and preparation of the fiber, which they will not derive in any other way.

The proper application and carrying out of the above-mentioned remedies is perhaps one of the most serious economic problems that at present confront the Filipino people. Its satisfactory solution will call for a thorough investigation and understanding of present conditions as well as for coöperation on the part of all parties directly interested in the welfare of the abacá industry. That the institution of such a reform is difficult of accomplishment and that it will have to be worked out gradually no one doubts; but since it must be accomplished sooner or later, there is no time more appropriate for beginning than the present.

MAGUEY (CANTALA) AND SISAL IN THE PHILIPPINES.

By M. M. Saleeby, *Chief, Fiber Division.*

INTRODUCTORY STATEMENT.

The maguey plant (*Agave cantala* Rox.) bears a close resemblance to the true sisal plant (*A. sisalana* Per.) and the henequen plant (*A. fourcroydes* Lem.). The products of these plants also, though differing somewhat in color and fineness, are similar and can be used practically for the same purposes, especially when they are prepared by the same methods. Until a comparatively short time ago nearly the entire supply of the so-called sisal fiber of commerce was produced by the Mexican species—henequen. During the last decade, however, the superior qualities of the products of the true sisal and the maguey plants have become more generally known to the commercial world, resulting, especially in the case of the former, in a somewhat rapid development of these two industries. Such a development, however, took place only in those countries where modern methods were used in the cultivation of the plants and in the preparation of their fiber. Thus we hear of the successful raising and production of sisal in East Africa, the Bahamas, and Hawaii, and of maguey and sisal in Java, in all of which countries the industry is carried on along the same lines as with henequen in Mexico.

The maguey plant is very widely distributed throughout the Philippine Archipelago, where it has been grown for many years and where it appears to flourish and attain its maximum growth and development. The production of maguey fiber in the Philippines for commercial purposes did not begin until the year 1904. Since 1906 the industry has remained practically stationary with no material improvement in the methods of cultivation and fiber extraction and with no increase in the area cultivated nor in the amount of fiber produced. The following statistics will serve to illustrate the difference in the development, since

1904, of the sisal industry of German East Africa and the maguey industry of the Philippines:

Year.	Sisal exports (German East Africa).	Maguey exports (Philippines).
	Metric tons.	*Metric tons.*
1904	765	690
1905	1,397	1,911
1906	1,854	2,443
1907	2,830	2,681
1908	3,897	1,887
1909	5,284	4,066
1910	6,971	2,606
1911	[a] 8,500	4,270
1912	(b)	6,767

[a] Approximate.

[b] The official figures have not yet been received, but it is believed that the exports exceed 10,000 tons.

The increase in the exports of maguey from the Philippines from 4,270 tons in 1911 to 6,767 tons in 1912 was due chiefly to the considerable advance in the price of the fiber since July, 1912.[1] As soon as the price becomes normal again, the exports will undoubtedly fall to between 3,000 and 4,000 tons. The exports of sisal from German East Africa, however, show a gradual and considerable increase since 1904, irrespective of the many turns that the fiber market has taken during these years. The history of the henequen industry of Mexico also shows a development identical with that of the sisal industry of German East Africa, the exports of henequen having increased from 81,000 tons in 1900 to over 120,000 tons in 1911.

To explain the reasons why the maguey industry of the Philippines has not developed at the same rate as that of sisal and henequen, and to show the means by which such a development can be attained, is therefore the aim of this paper.

HENEQUEN, SISAL, AND MAGUEY.

Before proceeding further with our subject, it will be necessary, as well as interesting, to give a brief description of the henequen, sisal, and maguey plants in order to show their relative merits as regards their respective habits of growth and the quality of their fibers.

Henequen.—This species produces a fiber of the same name, which is largely used in making binder twine. The plant lives fifteen to twenty-five years from the time of planting, and when

[1] This increase is also partly due to the failure of some of the other staple crops, as a result of the prolonged drought and typhoons during the same year.



Sisal (*Agave sisalana* Per.) plants at La Carlota Experiment Station.



Harvesting henequen (*Agave fourcroydes* Lem.).



Cleaning maguey (cantala) by "retting."



Harvesting maguey (*Agave cantala* Rox).

full grown it has a trunk one-half to 1½ meters in height. It is cultivated on a commercial scale practically exclusively in Mexico, particularly in the state of Yucatan. It requires for its development a hot dry climate and a well-drained limestone soil. The leaves bear lateral spines, are straight and rigid, and glaucous in color. The fiber is 1 to 1½ meters long, of a light reddish-yellow color, and rather coarse. It is known in the commercial world as "sisal," "Mexican sisal," or "Yucatan sisal." These names were given to the fiber before the true sisal was known to commerce. The fiber is cleaned entirely by machinery.

Sisal.—This plant is native to Mexico and Central America and was introduced into the Bahamas about the middle of the nineteenth century. From there it was later introduced into Hawaii, and was brought from this place to the Philippines about seven years ago by the Bureau of Agriculture. It is grown in Java and East Africa also, where it was recently introduced, probably from the Bahamas.

Sisal endures variation of soil and climate better than henequen, but its best development is obtained in well-drained limestone soils. It lives eight, ten, or more years, unless it is neglected, when its life is considerably shortened. The first harvest can be gathered four to five years from planting. The leaves are green or light green in color, rigid, and characterized by the total or partial absence of the lateral spines. The fiber is whiter, finer, and possibly stronger than henequen, and, when cleaned by machinery, commands a price somewhat higher than the latter. When cleaned by the retting method, in which the leaves are soaked in water for a period of five to nine days to soften the pulp, its market value is less than that of henequen. It is designated by the word "sisal" used after the name of the country in which it is produced, such as "East African sisal," "Hawaiian sisal," "Bahama sisal," etc.

Maguey (*cantala*).—This plant is cultivated in the Philippines, Java, and British India, to which places it was brought from Mexico. It lives from nine to twelve or more years, providing it is properly and periodically cultivated and harvested. The first crop can be obtained in three or four years when the plants are reproduced from suckers, and a year later when from bulbils. Like the sisal plant, it does not develop a real trunk. The leaves are of a grayish-green color, are longer and less rigid than either the sisal or henequen leaves, and, like the latter, bear lateral spines. The fiber when cleaned by machinery is finer, whiter, and probably more flexible than either the sisal or henequen and

commands a higher price. Its quality and commercial value with relation to the other two fibers is reversed when it is cleaned by the retting method. The Philippine product is known by the names "Manila maguey," "Manila aloe," and "Philippine maguey;" the Java product, by the names "Java sisal," "cantala," etc.; and the Indian product by "Indian sisal" and "Bombay aloe."

The above description of the plants and their fibers makes clear the following points: First, the henequen, sisal, and maguey plants are very similar in their general outward appearance, and in their habits of growth; second, they require for their best development similar soil and climatic conditions; third, their cultivation and the extraction of their fiber can be effected by exactly the same methods and means; and, fourth, the maguey fiber is equal, if not superior, to sisal and henequen.

MAGUEY IN THE PHILIPPINES.

The manner in which the maguey industry in all its phases has been, and is still being managed in the Philippines, leaves a great deal to be desired. The plantations are, as a rule, too small and too far apart, thus rendering the use of fiber-extracting machinery impracticable. Ever since the decline in the price of fibers in 1908 and 1909, the planters in the chief maguey provinces, such as Ilocos Sur, Ilocos Norte, La Union, and Cebu, have kept up the cultivation of maguey mainly as an emergency crop. Thus when typhoons, droughts, or locusts cause a shortage in the production of rice, corn, or some other of their staple crops, they turn their attention to maguey and endeavor to clean enough fiber to tide them over until the other crops again come in. During such years, however, there is an increased production of maguey.[1] This custom has unfortunately led to the practice of the ruinous method of overharvesting the plants, by which many plantations have been ruined.

The maguey fiber is prepared by retting the leaves in salt water in order to soften the pulp and facilitate cleaning the fiber by hand. This method is not only tedious and discouraging to any attempt to extend the cultivation of the plant, but it also injures the fiber to a considerable extent by destroying several qualities which determine its usefulness and value. It is due to this method of fiber extraction that the value of Philippine ma-

[1] This explains in part the rather variable production of maguey in the Philippines. See statistics on page 184.

guey is lower and the demand for it less than for sisal and henequen.

Summing up the situation as it exists in the Philippines, it would seem that maguey is generally raised as an emergency crop, and as such it will be difficult, if not practically impossible, to encourage its cultivation on a larger scale and by the use of modern and systematic methods.

A review of the history of the development of the henequen and sisal industries in the countries where they are now firmly established will show that these industries remained in a dormant state, similar to the present condition of the maguey industry here, so long as the crude and antiquated methods of planting and fiber extraction were in use. The present flourishing condition of the henequen industry in Yucatan and the sisal industry in the Bahamas, East Africa, and Hawaii, was brought about not only by the existence in the above countries of suitable natural conditions, but also by the adoption by the planters there of proper cultural methods, and by the use of machinery for extracting the fiber.

The maguey fiber, as mentioned before, is equal, if not superior, to sisal and henequen. Natural conditions in certain provinces in the Philippines are entirely favorable for the growth of the maguey plant and the proper development of its fiber. Therefore, what is required here to establish this industry on a firm basis and afford it every opportunity to develop is to discard the crude and antiquated methods now in use and to substitute for them the more improved methods of the principal sisal and henequen-producing countries. Such a substitution will bring under cultivation to maguey immense tracts of land in certain provinces, which, on account of their unsuitability for raising any of the principal Philippine crops, have been lying idle for years. Such a substitution will also bring about the much-desired improvement in the quality of the maguey fiber, and will enable it to compete favorably with both sisal and henequen in the fiber markets of the world. With an improvement along the lines suggested in this article, the maguey industry will develop to such an extent as to entitle it to a place among the leading agricultural industries of these Islands.

SISAL IN THE PHILIPPINES.

The history of the introduction of sisal into the Philippines dates back to the year 1905 when the Bureau of Agriculture began to import plants from Hawaii. The importation continued

until 1908, during which time more than two million plants were obtained and distributed throughout the Islands. It was at first believed that sisal was superior to maguey, and considerable interest was therefore taken in its cultivation. Recently, however, it was found that the sisal plant has a slower growth and a shorter life than the maguey. Its fiber also is neither more abundant nor of a better quality than that of the latter. Therefore enthusiasm in its cultivation in preference to maguey has considerably subsided, and it is now mostly grown in very small patches in connection with the latter.

During the last two years some sisal fiber has undoubtedly been produced and exported under the name "maguey." This is due to the fact that the producers recognize it as a variety of maguey. This confusion is also due to the retting method by which both fibers are cleaned, and which destroys their distinctive characteristics and renders their identification by buyers very difficult, if not practically impossible.

The sisal plant also grows luxuriantly and reaches its maximum growth and development here in the Philippines. It has some advantages over maguey, principally in the absence of lateral spines on the leaves, and the greater rigidity of the leaves. The absence of lateral spines makes the cultivation of sisal easier than that of maguey, and also saves the trouble of trimming the spines prior to fiber extraction. The rigidity of the leaves prevents them from breaking during strong winds, which often cause considerable damage to the maguey fiber.

What has been mentioned in the course of this article in regard to the prevalent methods of planting, cultivation, and fiber extraction in connection with maguey in the Philippines, applies to sisal without the least change or modification. Therefore, the remedies suggested for the one apply *en masse* to the other. Though the writer believes that the cultivation of maguey is, on the whole, more advantageous than that of sisal, yet he believes that both should be encouraged and developed to a much greater extent. In doing so, however, it will be necessary to distinguish between the two products and to place each on the market under its proper designation.

CORRECT TERMINOLOGY FOR THE SO-CALLED SISAL FIBERS OF COMMERCE.

By M. M. Saleeby, *Chief, Fiber Division.*

In an article in this issue of the Philippine Agricultural Review, the writer has explained that the so-called sisal fibers of commerce are distinct fibers produced by distinct species. This fact at once makes of paramount importance the question of giving them appropriate and distinctive names. Such nomenclature, however, in order to bring about the desired result, must be very generally adopted by both the commercial and scientific communities in all countries interested in these fibers. The present terminology for designating these fibers is both incorrect and confusing, and by it, it is impossible for any person to tell the identity of the fiber reported from a certain country, unless he happens to know the particular species grown there. If more than one of the three species is grown in that country, however, it will be quite impossible to tell the species of which the fiber referred to is the product.

Before the true sisal and maguey fibers became articles of commerce, the use of the terms "sisal" and "Mexican sisal" to designate the product of the Mexican species did not cause any confusion or doubt, for they could have referred to only one particular product. Now that the true sisal and maguey industries have been established in several countries, the term "sisal" can not be used indiscriminately without ambiguity. We now hear of "Mexican sisal," "Bahama sisal," "East African sisal," "Indian sisal," "Java sisal," etc., which do not designate one specified fiber, the word "sisal" being not only ambiguous but also misleading. "Mexican sisal" is the product of the species grown in Yucatan, Mexico—the henequen; "Bahama sisal" and "East African sisal" are the product of the true sisal plant; and "Indian sisal" and Java sisal" are the product of either the true sisal plant or the maguey (cantala) plant, both of which are grown in India and Java.

The product of the maguey plant of the Philippines, India, and Java is also designated by more than one term, there being no one established term even for the product of any one of the above-mentioned countries. Thus we hear of the terms "Indian sisal," "Bombay aloe," "Java sisal," "cantala," "maguey," "Manila maguey," "Manila aloe," etc. The first two terms are used to designate the Indian fiber; the next two, the Java fiber; and the last three, the Philippine fiber, all of which are produced by the same plant (*Agave cantala*). The fiber manufacturers undoubtedly buy the products of the three countries, believing they are the products of distinct species, while in fact whatever differences exist between them are due to the methods used in their preparation, and partly perhaps to differences in soil and climate. Such differences, however, are not more prominent than those that exist between the commercial grades of any one fiber. Besides the above confusion, the terms applied to the Indian and Java products of this plant are also applied to the products of the true sisal plant which is also grown in both countries.

The fiber manufacturers in Europe and the United States are always loath to make any change in the names of the products they handle. This attitude on their part can be justified only when the terms used by them are accurate, distinctive, and of established general use. But since with respect to the fibers in question the terms used are inaccurate, ambiguous, and indistinctive, it becomes necessary to drop these and adopt in their place other distinctive terms which will remove any ambiguity or inaccuracy.

To obviate such confusion and inaccuracy as are now encountered in the present system of nomenclature for these fibers, it is necessary to substitute another system which shall involve a fewer number of terms which are both accurate and distinctive, and which are, on the one hand, not altogether foreign to the markets of the world, and, on the other, not foreign to the producers. The writer recommends the following terms, which, it is believed, can come into general established use without any difficulty or confusion:

Henequen, to be used to designate the fiber produced by the Mexican species of the same name (*Agave fourcroydes*); *sisal*, to designate the fiber produced by the true sisal plant (*A. sisalana*), which is now grown commercially in the Bahamas, Hawaii, East Africa, India, Java, and other countries; *maguey* (can-

tala),[1] to designate the fiber produced by the maguey plant (*A. cantala*), which is also grown commercially in the Philippines, Java, and India. With each of the last two terms it will be appropriate to use the name of the country in which the fiber is produced, such as "East African sisal," "Bahama sisal," "Manila maguey" (cantala), "Java maguey" (cantala), "Indian maguey" (cantala), etc. In the case of henequen, however, it is not necessary to prefix the name of the country in which it is produced, as it has not yet become of any commercial importance outside of Mexico.

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[1] The word "maguey" is retained because the term "cantala" is, as yet, foreign to commerce. It is, however, intended that as soon as the latter becomes more known, the term "maguey" can then be dropped.

"Maguey" is used in preference to any of the other terms used in Java and India for the reason that it is better known and more distinctive in this case than the latter. This choice is made notwithstanding the fact that several agave species in Mexico are known as "maguey" none of which have so far become of any commercial importance.

CURRENT NOTES—APRIL.

NOTES BY M. M. SALEEBY, Chief, Fiber Division.

BURÍ RAFFIA.

The true raffia fiber of commerce is produced by the raffia palm of Madagascar, *Raphia ruffia* (*R. pedunculata*). It is obtained from the cuticle, or epidermal layer, of the leaflets before they are fully expanded. The leaves are cured the same day they are cut and the thin, epidermal, fibrous strips are divided into narrower strips, ranging from 1½ to 2 centimeters in width and about 1 meter or more in length. This division is made by means of special combs similar to those used in dividing hat straws or fibers. This raffia is used in the United States as a substitute for Russian bast as tie bands by gardeners and nursery men. In England it is woven into a superior matting for covering walls as a substitute for tapestry. In Madagascar the natives use it for making hats, mats, and as a tying and wrapping material. It is said that the preparation of raffia both for domestic and commercial uses is one of the most extensive household industries in Madagascar.

The true raffia palm is not found in the Philippines, but a similar raffia has for some time been prepared from the leaflets of the burí palm (*Corypha elata*) by the Filipinos. The method used in preparing this raffia is similar to that used in Madagascar. Samples of true raffia from Madagascar and burí raffia have recently been received by the fiber division of this Bureau, and comparative tests of them were made. The burí raffia was superior to the true raffia in color, fineness, and luster; but the latter proved to be about 30 per cent stronger. The strips intended for the strength tests were 40 centimeters long and 1 centimeter wide, and the results of the tests were as follows:

Sample No.—	Breaking strength in kilograms.	
	Raffia.	Burí raffia.
1	10.3	4.5
2	6.4	5.1
3	7.9	6.65
4	6.8	4.35
5	6.35	4.9
6	10.3	6.8
7	7.25	7.2
8	6.45	5.5
9	8.2	9
10	8.1	6
Average	7.8	6

It is believed, however, that if the burí raffia is prepared so as to be of the same thickness as that of the true raffia, it will prove to be equally as strong as the latter. Hence there is no reason why the burí raffia of the Philippines can not be employed for all the purposes for which the Madagascar raffia is used. Burí raffia might probably be used in preference to the latter in all articles in which color and luster are essential qualities.

PACOL FIBER.

Pacol is a species of *Musa* which closely resembles the sabá (banana)-variety of the Philippines in its general outward appearance. It is extremely hardy of growth and produces a large number of huge stalks which are pale green in color. The leaves are similar to those of most banana varieties, though as a rule they are wider and less tapering than the latter. The seed pod is generally cylindrical in form, about 6 to 8 centimeters in length and circumference, and full of large black seeds similar to those of abacá, though considerably larger in size.

The pacol plant may be seen growing along the bases or lower slopes of mountains in several of the larger islands of the Archipelago, but more especially in Mindanao, Negros, and southern Luzon. In certain localities in southeastern Mindanao and in Negros, pacol spreads so rapidly and grows so luxuriantly as to actually become a menace to adjoining plantations. It is propagated from seed by birds which are fond of the fleshy part of its pods.

Pacol, like any other species of *Musa,* produces a fiber which is said to be stronger than that of the banana, but undoubtedly much weaker than abacá. It may therefore be suitable for use in the lower grades of binder twine, but not for cordage purposes. It is prepared for commercial purposes in southern Luzon, and is usually of an inferior grade, for, owing to its weakness, the strippers are forced to loosen the tension of the knife on the table.

The pacol fiber has a value equal to that of the lowest grades of abacá, or slightly less. It is so similar to one or the other of the low grades of abacá that only experts can distinguish it from the latter. For this reason, pacol is sometimes mixed with abacá, especially when a shortage in the latter is expected. This practice is extremely unfortunate and every attempt should be made to discourage it. Abacá ranks as the premier cordage fiber because of its superior strength. If this quality is lowered or in any way impaired by mixture with a weaker fiber, abacá will

lose the characteristics for which it is particularly desired. Uniformity in strength is just as essential for many purposes as the absolute quality itself. The weak and the strong fiber have their respective use and value, when kept separate; once they are mixed together, however, the value of the mixture is of necessity reduced to that of the weaker fiber. It is an established fact that the strength of a rope or cable is determined by the strength of its weakest part. If such a part is too weak to stand the necessary strain, then the whole rope is discarded as worthless for that particular purpose. Thus it is feared that if the practice of mixing pacol with abacá is allowed to continue, the reputation of abacá may be seriously injured.

THE ABACÁ SITUATION IN NORTHEASTERN LEYTE.

During the month of January of this year, Mr. F. P. Nickles, of the fiber division of this Bureau, made a trip through the municipalities of Burauen and Dagami in northeastern Leyte for the purpose of securing seed from the principal abacá varieties grown there. The seed was intended for planting at the La Carlota experiment station, Occidental Negros, in connection with abacá and other fiber experiments that are being conducted there. In securing such seed, Mr. Nickles had occasion to visit a large number of the plantations and his report on conditions as they existed there at the time is here reproduced:

During the month of January I had an opportunity to visit the abacá plantations in the vicinity of Burauen and Dagami in the Province of Leyte and the following notes refer to that district.

The feeling shown among the abacá planters was, in some respects, peculiar, for between the losses caused by the drought of last year followed by the typhoon of November and the present excellent prices for the fiber, they were uncertain whether to feel elated or depressed. In reality the situation is rather serious. The planters at the time were stripping those plants which were blown over or otherwise damaged by the storm. As the abacá stalks after injury soon become partly decayed, causing discoloration and weakening of the fiber, the result is an increased production of inferior fiber. The effect is not felt so much now as it will be a few months hence. A large part of the injured abacá which comprises most of the mature stalks is already harvested and within a few months the planters will have to clean immature stalks or wait until the new stalks will have attained their full growth. I believe that the drought and the typhoon have set back the abacá crop from six to eight months.

The situation is not hopeless, but a great deal depends upon the planters themselves. In no province in the Islands are reforms in the industry needed more than in Leyte, and there should be an added incentive to inaugurate some of them, such as the practice of better methods of cultivation and harvesting, a stand for proper prices for the better grades of

fiber from the middlemen, and the elimination of the middleman wherever possible.

The production of abacá has fallen off perceptibly since December of last year and at the present time large quantities of inferior fiber are being produced, and it is a question whether the present prices will hold until the abacá plants regain their normal stage of growth. The steadily increasing demand for abacá fiber of the better grades is a fair assurance that the prices of these grades will continue good, and good prices should encourage the planter and give him an opportunity to improve his plantation as well as the product.

PHILIPPINE SABUTAN HATS.

The sabutan plant of the Philippines was first described by Blanco under the name *Pandanus sabutan*. Recently, however, it has been identified as a variety of *Pandanus tectorius*. This plant is of common occurrence here in the Philippines, where it is commonly grown in gardens as an ornamental plant. In a few localities, more especially in Mabitak, Laguna, it is grown somewhat extensively for economic purposes, such as the manufacture of hats and mats from the leaves.

A very strong and durable kind of hats, now known to local trade as "sabutan hats," is made from the young leaves before they are fully expanded. At this stage the leaves are of a pale-greenish color and about 1½ or 2 meters in length. Immediately after they are cut, the lateral and dorsal spines are trimmed off and the leaves are dried in the sun for a period of two hours or longer. After this partial drying the leaves are divided in the middle, the midrib is removed, and each half of the leaf is subsequently split into narrower strips by a comb-like instrument, the width of the strips depending on the grade of the hat required. After the splitting operation is completed a blunt-edged bamboo blade is passed over these strips for the purpose of removing all projecting fibers formed during the operation of splitting. After this operation is completed, the strips are then boiled in clean water for about one and one-half hours, after which they are soaked in cold fresh water for two days. At the end of this period the leaves are again washed and are afterwards spread in the sun until they are quite dry. Then the same bamboo knife that was used before is again passed over the strips, this time to give them a smooth and glossy appearance, after which the strips are ready to be woven into hats.

The above process of preparing the sabutan strips for hat making is identical with that used in the preparation of the

leaves of the panama-hat plant for the same purpose. The sabutan hats are also very similar in appearance to, and are quite as strong and durable as, the latter, if not more so. The only qualities in which a panama hat is superior to a sabutan hat are pliability and color. The superior pliability of the panama hat is probably due to the leaf of the plant being naturally softer and more pliable than the sabutan leaf. The panama hat is also of a superior color, which is either due to a better process of bleaching, or to a stronger affinity for bleaching, probably more to the former. Its color is also more uniform than that of the sabutan hat, which is unquestionably due to a more careful selection of leaves of uniform color and development.

The sabutan hat as it is at present made and bleached does not retain its color for any reasonable length of time, and requires bleaching oftener than the ordinary person cares to have this done. The writer believes that the sabutan hat possesses many superior qualities which warrant extensive experiments and tests, designed to discover some bleaching process by which it will retain its color more permanently. Uniformity in its color, however, can be easily obtained by a more careful selection of leaves of the same stage of development.

At the present time it appears that the demand for the finished sabutan hat for the trade is not as encouraging as it should be. There is, however, a demand for the prepared leaves, or strips, which goes to show that there is no objection to the material itself on the part of buyers. Whether this demand is caused by a successful discovery of a bleaching process by some hat manufacturers or to extensive attempts and tests being made by them for its discovery can not at present be determined. The present prices [1] for sabutan leaves are as follows:

1. Leaves prepared for hat making (cured, boiled, etc.), ₱0.30 for enough to make one man's hat, if the strips are 3 millimeters wide; and ₱0.70, if the strips are $1\frac{1}{2}$ millimeters wide.

2. Leaves cut in half only, with midrib and spines separated, ₱1 to ₱1.20 per kilo.

It is believed that until such time as sabutan hats suitable in every respect to the requirements of the market can be made, it would be advisable for all owners of sabutan plantings to prepare and sell the material in any of the above forms, if the prices are considered a sufficient inducement.

[1] Given by Messrs. G. Martini & Co., Manila, who are willing to buy any quantity at the above-quoted prices.

NOTES BY P. J. WESTER, Horticulturist.

NEW LIGHT ON THE NITRATE FIELDS OF CHILE.

According to Mr. W. S. Myers, the Chilean delegate to the Eighth International Congress of Applied Chemistry, the world might well have been spared the nitrogen-famine panic of some years ago. Mr. Myers thus sums up the situation: "First of all there is a vast amount of unsurveyed nitrate ground on the Chilean pampas that is, nevertheless, known to contain immense quantities of nitrate of soda. Second, grounds already surveyed still contain enormous quantities of nitrate. There are probably, in round numbers, one billion tons in the deposits of Chile, and, without doubt, large supplies also exist on land now but incompletely prospected. The surveyed and certified tonnage opened up at the present time already for extracting is fully 250 million tons. The probable life of the surveyed deposits is at least 400 years, even allowing for a steadily increasing annual rate of consumption."

AGRICULTURAL DEVELOPMENT OF LATIN AMERICA.

Notwithstanding frequently recurrent revolutions the Latin-American States are forging rapidly ahead agriculturally and industrially.

The wheat exports of Argentina, perhaps the most advanced of the South American republics, now surpass those of the United States. In the Province of Cordoba the Pichana River will be dammed for irrigation purposes at an estimated cost of 3 million pesos, and in another province, La Rioja, a survey has been authorized for the construction of an irrigation system to make use of the Famatina waters. The Argentine Government has also engaged the services of a Japanese to conduct experiments in rice culture in the Province of Missiones. In August, 1912, 97,081 tons of sugar were produced from 1,486,036 tons of cane in Tucuman.

In Brazil plans have been prepared for a reservoir in the State of Parahyba at an estimated cost of two million pesos. This reservoir, which will be on the River Peixe, will have a capacity of 219,250,000 cubic meters and will irrigate an area approximately 60 kilometers in length and 18 kilometers in width.

Cuba produced 1,895,984 tons of sugar in 1911–1912, an increase of 412,533 tons over the preceding season.

Both in Nicaragua and Panama there is increasing interest in banana growing. The Rio Grande Valley of Nicaragua is expected to export 30 to 40 thousand bunches of bananas per

week by the end of the current year. On some of the tributaries of the Rio Grande, such as Karawalla, banana growing is expanding rapidly at the expense of stock raising, hitherto the chief industry in that part of the Republic.

STOCK RAISING IN BRITISH EAST AFRICA.

It is not generally known that the highlands of British East Africa are eminently suited to pastoral pursuits. Notwithstanding the situation of the country in the equatorial belt, the climate, due to the altitude, is ideal, and the land is well watered and rain abundant. In this the country is very similar to our own highlands in Mindanao. The "fly in the ointment" or flies rather, are the presence of Texas fever, African coast fever, pleuropneumonia, trypanosomiasis, the tse-tse fly, and, in isolated districts, rinderpest. However, a well-organized department of agriculture is said to have these diseases well under control.

The British Government has now been experimenting for some ten years with breeding the native humpbacked cattle to Shorthorns, Ayreshires and Herefords with the result, according to the "Outdoor World and Recreation," that they have greatly improved the native cattle.

Sheep raising is also said to be very profitable and a new race has been produced, well adapted to the conditions and yielding an excellent wool, by crossing the native black fat-tail sheep with imported pure-bred merinos.

THE PROFITS IN PINEAPPLES.

The Bureau is in receipt of a communication from Mr. J. E. Higgins, horticulturist of the Hawaii Agricultural Experiment Station, of which the following excerpt should be of interest to the prospective pineapple grower in the Philippines. The quotation refers to the pineapple in Hawaii: "The yield of fruit per acre [1] ranges from 10 to 20 tons and is produced approximately once in two years. This great variation in yield is partly due to the difference in the methods of planting. Some soils seem to take care of 10,000 plants per acre, while most of the land planted to this crop in Hawaii supports only 5,000 plants. The price received for the fruit at the cannery varies from $17 to $25 per ton for first-quality fruit weighing 3 pounds (1.35 kilograms) each and upwards. Smaller fruit than this brings half price and is used in the manufacture of the cheaper grades of the canned product. At these prices the industry is here regarded as a very profitable one."

[1] 1 acre equals 0.4 hectare.

RINDERPEST SITUATION—MARCH 1, 1913.

By STANTON YOUNGBERG, *Supervising Veterinarian.*

Ambos Camarines.—The only known infection in this province is in the municipality of Magarao, the last report showing one infected animal.

Cagayan.—Rinderpest exists in the municipalities of Aparri and Lallo. In Aparri there were deaths of over a hundred head of cattle, the majority of which were very susceptible animals that had been brought in from Fuga and other islands to the north. The virulence of the disease in this outbreak is on the decrease.

Ilocos Norte.—In the province there are at present 4 infected municipalities: Dingras, Solsona, Piddig, and San Nicolas, involving nine barrios. Dingras was the only municipality that showed new cases during the week ending March 1. The force engaged in rinderpest eradication consists of one Bureau of Agriculture veterinarian and 10 Filipino inspectors employed by the province. The local officials and the people have given splendid coöperation.

Isabela.—The last known case of rinderpest occurred in Ilagan. The disease in this province is of a mild type with a low mortality and for this reason does not cause much alarm among the people.

La Union.—At the beginning of the year this was the worst infected province in the Archipelago. On March 1 there were only 2 infected municipalities, Luna and San Fernando, with 1 barrio in each, that in Luna being the only one with a new case during the previous weeks. The provincial and municipal officials have given excellent coöperation with the result that the province of Union shows promise of being free from rinderpest in a few weeks.

The Bureau forces have been admirably assisted by six companies of Philippine Scouts, without whom it would have been impossible to enforce the effective quarantines that have resulted in cleaning up a badly infected province in a few weeks'

time. All of the municipalities of Union Province, the adjoining *rancherías* of Benguet, and all of the municipalities and townships of Amburayan subprovince have been under a fifteen-day tie-up and thoroughly inspected by the Bureau of Agriculture forces and Philippine Scouts. This same system has now been inaugurated in the southern portion of Ilocos Sur, and it is proposed to continue northward into Ilocos Norte with the object of making a thorough clean up of the entire Ilocos coast.

In the months of September and October the towns of Balaoan, Luna, and Bangar were found badly infected. At one time there was a total of 29 infected barrios. This was before the arrival of the Philippine Scouts. During this period, the quarantines were enforced with the assistance of the Philippine Constabulary, 60 soldiers being detailed for that purpose. In spite of the fact that this outbreak occurred in the midst of the rainy season, the men having to wade daily through mud and water, the work progressed so favorably that on the arrival of the Scout forces only one barrio of Luna was infected, the disease in Balaoan and Bangar having been entirely eradicated.

In all infected barrios, whenever possible, all carabaos and cattle have been placed in individual corrals, from 20 to 30 meters apart, provided with individual drinking vessels and cans for disinfecting the feet of the caretakers. By this method it has been found possible to eradicate the disease in a short space of time as unnecessary contact between animals is avoided and they can not run loose over the pasture fields, thus disseminating infection.

Mountain.—The only portion of this province infected with rinderpest has been the subprovince of Amburayan. Two towns were originally infected, Suyo and Tagudin, the former having been cleaned up in the month of December and the last case in the latter having occurred on the 3d of February. As mentioned above, the work in this province was carried on by the same forces that searched out Union Province, and the same system of individual corrals was employed in the infected barrios. Before the arrival of the Philippine Scouts in February, the Bureau forces were admirably assisted by the Philippine Constabulary.

Pampanga.—Pampanga at present is the center of interest and activity in the rinderpest campaign. During the week ending March 1 infection was recognized in 12 municipalities, involving 47 barrios. During this period 115 new cases were

discovered by Bureau employees or reported by municipal presidents, and 96 deaths occurred.

Two companies of Philippine Scouts are on quarantine duty in this province.

Pangasinan.—The only towns now infected are Dagupan and San Nicolas, with 3 and 2 barrios, respectively. During October Manaoag was badly infected, and in November and December a great deal of infection was discovered in several barrios of Santa Barbara and Urdaneta. The people of these places recognized the gravity of the situation and rendered good assistance, with the result that the disease has been eradicated in the three towns. The disease in this province has caused a mortality of less than fifty per cent with the result that the people do not become alarmed until it has spread over a considerable extent of territory and assumed serious proportions. The Bureau forces are being assisted by two companies of Philippine Scouts.

Zambales.—Rinderpest exists in 6 barrios of Masinloc and in 4 barrios of Palauig. The latest reports show 16 new cases in Masinloc and 26 in Palauig. The remaining municipalities of the province have been searched for disease by Bureau forces assisted by two companies of Philippine Scouts and are free from infection. There is at present one company of Philippine Scouts on quarantine duty in the two infected municipalities. The work in Masinloc has been rendered very difficult by the fact that the disease was found in herds of half-wild range cattle, which can not be easily isolated in individual corrals.

Visayas and Mindanao.—No rinderpest infection is known to exist in this territory. The last remaining centers of infection in Bohol, Iloilo, and Antique were cleaned up by the middle of January, 1913.

ANNOUNCEMENT.

The "International Rubber and Allied Trades Exhibition" will be held in London in June, 1914. In connection with this an "International Cotton, Fibers, Tropical Products, and Allied Trades Exhibition" will also be held at the same time in an adjoining building.

The general principle of the rubber exhibition is well known on account of the previous exhibitions held in London and last year in New York. The combined exhibition of next year promises to be one of the most interesting and beneficial exhibitions ever held, and every country which is interested in one or more of the phases of this exhibition should be represented for the benefit of its trade and commerce.

The tropical-products section of this exhibition will be held under the auspices of the Tropical Agricultural Association of which Professor Wyndham Dunstan, C. M. G., director of the Imperial Institute, is president. His Majesty King George V is patron; Sir Henry A. Blake, G. C. M. G., is president; and the Right Honorable Lord Elphinstone is vice-president.

Full prospectus of this combined exhibition will be issued in a few months.



Seven-year-old sisal plants at the "poling" stage, Lamao Experiment Station, Bataan (illustrating how lack of cultivation and harvesting induce early maturity).

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CONTENTS.

Page.

Editorial 205
Bureau of Agriculture Circular No. 22. Maguey and Sisal Culture 207
Additional Notes on Roselle 223
The Coconut Leaf-miner Beetle 228
The Fifth Annual Meeting of the Philippine Veterinary Medical Association 234
The Recent Campaign Against Rinderpest on the Island of Panay 236
Current Notes—May: Manchurian Beans; Burma Crops; Australian Meats; Coconut and Cocoa; Venezuelan Coconut Factories; The Lime Industry; Mexican Coconuts; Animal Husbandry in Mexico; Bag-worms; Ants Injurious to Okra; Tobacco Insects; Mechanical Insect Control; Natural Insect Control; Occurrence of the Coconut Weevil; Plants Resistant to Insect Attack; Cinchona; A New Oil Industry; The Olive-oil Crop in the Mediterranean Countries; Maté or Paraguay Tea; Fox Farming; *Carludovica palmata* in the Philippines; Anabo (*Abroma augusta*) 243
Announcement: Tenth International Congress of Agriculture, June 8-13, 1913, Ghent, Belgium 257
Temperature and Rainfall—February 259

118167

ILLUSTRATIONS.

PLATE I. Seven-year-old sisal plants at "poling" stage ..... *Frontispiece.*

Facing page—

II. Seven-year-old sisal plant 218
III. Three-year-old maguey plant 218
IV. Maguey plant at the "poling" stage 218
V. Branch of sisal "pole" 218
VI. (*a*) Three-year-old maguey plantation; (*b*) Maguey plant attacked by a fungous disease 218
VII. Coconut leaflets injured by *Promecotheca cumingii* Baly. (*a*) leaflets injured by adults; (*b*) leaflets injured by larvæ 232

TEXT FIGURES.

Page.

FIG. 1. Plan showing method of planting maguey or sisal 215
2. Coconut leaf-miner 229
3. Map of Panay 240

EDITORIAL.

THE PHILIPPINE VETERINARY MEDICAL ASSOCIATION.

By the ASSISTANT TO THE DIRECTOR.

The work of controlling and eradicating the diseases of domestic animals may well be considered as the building of a permanent foundation upon which the structure of industrial development in the Philippine Islands may be safely erected. The industrial prosperity of this country is based on its agriculture, and the most important branch of Philippine agriculture is the production of the food supply of the Islands. Our two leading food products, rice and maize, can not be successfully cultivated on a large scale without an abundant supply of work animals—a condition which can exist only when rinderpest is under control or entirely eradicated.

The vital importance of the rinderpest campaign has been fully appreciated and has received the hearty support of the Government. In general, it has received, also, the support of the people of the Islands. During earlier years, when the necessity for using vigorous measures in fighting rinderpest was not well understood, considerable opposition was encountered. While this feature of the campaign has not been entirely eliminated, it has been largely reduced, and in most provinces the local officials and the farmers give their hearty support in the rinderpest work.

For several years a large number of veterinarians have been employed by the Bureau of Agriculture. In addition to this force, we have in the Islands the veterinarians of the Army and those in private practice. In connection with the different lines of veterinary work carried on in the Philippines there are constantly arising problems, both technical and administrative, which are of interest to, and which should be considered by, the entire veterinary profession as it is represented in this country. Realizing the desirability of an organization that might facilitate such action, there was organized some years ago the Philippine Veterinary Medical Association. This association now includes in its membership the greater part of the veterinarians in the Philippine Islands, and it has been an important factor in promoting the larger interests of the veterinary work.

The individual members of the Philippine Veterinary Medical Association are engaged in a work of the utmost importance and one that can not fail to be of interest to veterinarians throughout the world. The nature of this work, the measures that are used, and the results that are obtained should be fully and clearly understood, not only in the Philippines, but also in other countries where trained men are endeavoring to control and eradicate the diseases of domestic animals. The Philippine Veterinary Medical Association, if properly supported, will be of inestimable benefit to the veterinarians of these Islands, and indirectly to the people for whom the veterinary work is being carried on. It should, furthermore, be the principal means by which information may be furnished the entire veterinary profession regarding the animal-disease campaign in the Philippine Islands.

BUREAU OF AGRICULTURE CIRCULAR No. 22—MAGUEY (CANTALA) AND SISAL CULTURE.

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MAGUEY (CANTALA) AND SISAL CULTURE.

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INTRODUCTION.

The maguey plant of the Philippine Islands (*Agave cantala* Rox.), the true sisal plant (*A. sisalana* Per.), and the henequen plant of Mexico (*A. fourcroydes* Lem.) are the species which produce the so-called sisal fibers of commerce. Of these the last (henequen), which is practically exclusively grown in Mexico, is by far the most important, and its product constitutes about 80 per cent or more of the world's total production of sisal. The first two, however, produce a fiber as good in quality as henequen, if not slightly superior. They also endure variation in soil and climate better than the latter, hence the interest in their cultivation has recently considerably increased, and they are now grown on a more or less large scale in several tropical countries both in the Eastern and Western Hemispheres. The details connected with their planting, cultivation, and fiber production are essentially the same, which fact explains their treatment under one subject.

The essential features of maguey and sisal culture which should recommend them to the Filipino planters are their peculiar adaptability to conditions prevailing in certain parts of the Philippine Islands. These conditions may be summed up as follows: A long dry season; large tracts of rocky and somewhat impoverished soil; the prevalence of locusts and other insect pests; the scarcity of skilled labor; and the lack of sufficient capital for the purchase of work animals and agricultural implements and machinery. Maguey and sisal will flourish in comparatively poor rocky limestone soils and will withstand long periods of drought; their cultivation is both simple and inexpensive, not requiring skilled labor, work animals, or agricultural machinery; and they are not attacked by any serious diseases or insect pests.

The cultivation of sisal and maguey for fiber production has recently been successfully accomplished in several tropical countries which apparently have no advantage over the Philippines in regard to any of the essential requirements. Thus we hear of the successful cultivation and production of sisal in the Bahamas, East Africa and Hawaii, and of maguey and sisal in Java. The maguey and sisal plants are very widely distributed throughout the Philippines, the former having been grown here for many years while the latter was introduced about eight years ago by the Bureau of Agriculture. Both plants appear to flourish and attain their maximum extent of growth and development, nevertheless their cultivation has not been so successful as in other countries. The production of maguey in the Philippines for commercial purposes did not begin until the year 1904. Since 1906 the industry has practically remained stationary with no material improvement in the cultural methods nor an increase in the area cultivated or amount of fiber produced. The production of sisal from German East Africa has increased from 1,854 tons in 1906 to about 9,000 tons in 1911, while the production of maguey in the Philippines has increased from 2,443 tons to 4,270 during the same period. The exports of maguey from the Philippines during 1912 show an increase of about 2,000 tons over those of 1911, due only to a temporary rise in the value of the fiber; while the exports of sisal from German East Africa show a gradual and substantial increase every year since 1904.

A recent reawakening of general interest in the cultivation of maguey and sisal in the Philippines has been exhibited by planters in several provinces. A noticeable increase in requests for information regarding various phases of the industry and for suckers and bulbils has confirmed the above reawakening. It is therefore the aim of this circular on the one hand to furnish the required information, and on the other to indicate the lines upon which present methods should be improved in order to bring about the desired development of the industry. Information of a more detailed nature will be given later in a special bulletin on the subject.

SISAL AND MAGUEY.

It appears to be a general belief among the planters in the Philippines that sisal and maguey are varieties of the same species, and that further than the absence of the marginal spines on the leaves the latter is the same as the former. It is, there-

fore, important at this point to correct this impression by giving a description of both plants, which will show plainly the real, though not very marked, differences between them in their outward appearance, their habits of growth, and the relative qualities of their fibers. Though the same methods are used in cultivation, the two plants are separate species, producing somewhat distinct fibers, and they should be raised separately and their fiber produced and marketed separately.

Sisal.—This plant endures variation of soil and climate, hence the fact that it is very widely cultivated throughout the Tropics. It is even known to grow in semitropical countries where some frost occurs, but its best development is obtained in tropical countries having a somewhat dry climate and well-drained limestone soil. The first harvest of leaves is ready for fiber extraction about four years from planting, and with proper care and cultivation the plant lives eight to ten or more years. The leaves are green or light green in color, rigid, and characterized by the total or partial absence of the marginal spines. When cleaned by machinery the fiber is white or slightly yellowish in color and of good luster. If cleaned by the retting method, the fiber is of a dull-gray color. Well-cleaned sisal is now quoted at about 32 to 34 centavos per kilo in the New York market, while hand-cleaned sisal sells 4 to 6 centavos less than the former. The fiber is designated by the word "sisal" used after the name of the country in which it is produced, such as "East African sisal," "Hawaiian sisal," etc.

The sisal plant was introduced into the Philippines from Hawaii about seven years ago by the Bureau of Agriculture. Though several million plants have been introduced and distributed, it is nowhere cultivated on a large scale, its cultivation being so far restricted to small patches in connection with maguey.

Maguey.—This plant endures variation of soil and climate as much as if not more than sisal. It is cultivated in the Philippines, Java, and British India, where it must have been introduced a few hundred years ago from Mexico. It lives ten to twelve or more years providing it is cultivated and harvested periodically. The requisite soil and climate conditions with which its best development can be obtained are the same as those for sisal. The first harvest of leaves can be gathered three and one-half to four years from planting. The leaves are of a grayish-green color and are longer, somewhat narrower, and less rigid than sisal leaves. They also differ from the latter

in having many prominent marginal spines similar to those on the henequen leaves. The fiber, when cleaned by machinery, is somewhat finer, whiter, and probably more flexible than sisal. The retting method of cleaning destroys the choice and distinctive qualities of this fiber and renders it identical with, though perhaps slightly finer than, retted sisal, hence the difficulty of distinguishing the two fibers as exported from the Philippines. Maguey is exported from the Philippines under the name of "Manila maguey," "Manila aloe," and "maguey."

The above description makes clear the following important facts: First, both the sisal and maguey plants, though somewhat resembling one another in their general outward appearance, are distinct species, producing distinct fibers which have different commercial values; second, the two species require practically the same soil and climate conditions for their best growth and development, and their fibers can be extracted by identical methods; and third, the only hope of their attaining more commercial importance in the face of competition from henequen and other hard fibers lies in the employment of machinery for cleaning their fibers.

CLIMATE AND SOIL.

The maguey and sisal plants endure variation of soil and climate better than most other tropical plants of economic importance. They do not require as abundant and evenly distributed a rainfall nor as rich a soil as are required by abacá (Manila hemp), coconuts, coffee, cacao, and other tropical crops. In a rich soil and a wet climate maguey and sisal apparently grow luxuriantly, but the quality and yield of their fiber are not as a rule at their best; besides, under these conditions the cost of cultivation and fiber extraction is considerably higher than in a poorer soil and a drier climate.

A long dry season and a short rainy one may on the whole be considered essential for the best growth of these plants and the development of their fiber. Their thick and pulpy leaves render them capable of withstanding long droughts which would be disastrous to most other economic tropical plants. Frost and sudden changes of temperature, especially the former, however, are undesirable.

Well-drained limestone soils, such as are formed by the disintegration of coral rock, appear to be best suited for growing sisal and maguey for fiber production. Even though such soils are in most cases stony and hard, good results are obtained, for

these plants are very hardy and their roots can penetrate such soil to a sufficient depth to enable them to obtain the required amount of nourishment necessary for their development. This, however, should not be construed to mean that they flourish in rocky land devoid of soil of sufficient fertility. Sandy soils, such as occur near the seabeach, often give fairly good results, providing they are sufficiently distant from the reach of salt water. All low or swampy land in which standing water comes in contact with the roots or in which the water takes a long time to run off should be avoided. These plants do not thrive in wet soils, for their roots are sensitive to moisture and in such soils they either die outright or linger on in an unhealthy condition.

PROPAGATION.

Sisal and maguey produce suckers and bulbils, or "pole" plants, but no seeds. Their propagation therefore can be effected only by the use of either of the first two means.

Suckers appear about the second or third year from planting. They grow around the mother plant and spring from the underground runners, or rhizomes. From 30 to 40 suckers are ordinarily produced by one plant during the first four years of its age, after which the number decreases until the plant has reached the "poling" stage. Suckers intended for planting should be dug up when they have attained a height of 15 to 25 centimeters, and should be secured, if possible, from plants between 4 and 6 years of age. If they are somewhat dried, the suckers can withstand shipment for long distances. They are usually set out in the field without any preliminary operation, except perhaps trimming off the older leaves.

Bulbils, or "pole" plants, are produced on the branches of the flower stalk which grows from the center of the plant at the time it reaches maturity. When the flowers have withered and fallen to the ground, the flower stalk does not immediately die, but at the ends of the branches are produced these numerous small bulbils which eventually develop into small plants 8 to 10 centimeters in length, and then fall to the ground. These bulbils are usually set out in a nursery for a period of six to ten months, or until they have attained a height of 20 to 25 centimeters, after which they are transplanted to the permanent field. The nursery should be properly prepared and kept clean from weeds all the time. The shading of the young plants is not necessary, providing they are kept watered occasionally until their roots have established themselves.

If sufficiently dried and properly packed, these bulbils will retain their vitality for a longer period than suckers. They are also much smaller in size, cheaper to collect, and easier to pack than the latter. If a plantation is to be started in a locality where the necessary supply of suckers can be obtained from the neighborhood without much expense and difficulty, then the use of suckers is to be preferred to that of bulbils, for the former grow more quickly and can be cultivated at less expense than the latter. Only in cases where either suckers or bulbils have to be imported from distant localities or from foreign countries, will the use of the latter be preferred to that of the former.

PLANTING.

The suckers or nursery plants should be set out in straight rows not less than $1\frac{1}{2}$ by $2\frac{1}{2}$ meters nor more than 2 by 3 meters apart. Distances ranging from $1\frac{1}{3}$ by $1\frac{3}{4}$ meters to 3 by 3 meters have been recommended by various authors. The distance varies to some extent with the species cultivated and the nature of the soil. As a rule, the plants may be set out closer together in poorer than in richer soils. Also sisal plants, on account of the stronger rigidity of their leaves and the absence of marginal spines on them, may be planted somewhat nearer together than the maguey plants.

If the plants are set out closer together than $1\frac{1}{2}$ by 2 meters, the leaves (especially in the case of maguey) will cross and cut each other during strong winds, thus causing considerable damage to the fiber. Besides preventing such damage to the fiber, there are several other advantages resulting from a wider planting than is ordinarily practised in the Philippines. These are: First, to allow of the free circulation of air and access to sunlight, which will greatly stimulate the growth of the plants and tend to check the spread of certain diseases and scale pests which sometimes attack the leaves; second, to allow of the practice of the proper methods of cultivation and harvesting; third, to render possible the growing of certain secondary crops during the first two or three years of the life of the plants; and fourth, to give the roots a larger soil area from which to obtain the necessary supply of plant food, which will enable them to thrive better and perhaps live longer.

CULTIVATION.

Where the land is arid and rocky the suckers or nursery plants may be set out with but little preliminary preparation of the soil. If, however, the land is overgrown with underbrush or weeds,

as most localities in the Philippines are to a more or less extent, then it becomes necessary to clear the soil and burn the waste prior to planting. This operation should be repeated periodically thereafter in order to prevent any such growth from ever shading the plants. Wherever practicable to do so, the land may be plowed and a secondary crop raised, providing such a crop does not shade the young maguey or sisal plants nor in any other way seriously interfere with their growth and development. Where the land is thus prepared, maguey and sisal will grow unchecked and the secondary crop will considerably reduce the cost of the upkeep of the plantation until the plants can be harvested.

Besides the above operations connected with the cultivation of maguey and sisal prior to and after planting, the periodical cutting or digging up of the suckers from around the mother plants is another operation which requires the constant attention of the planter. Whether there is a demand for such suckers or not, the fact remains that under no circumstances should they be left, for as long as they remain attached to the mother plant, especially before they have become old enough to send out roots of their own, they deprive it of a large part of its nourishment and induce its early "poling." These suckers are more abundant in rich than in poor soil, and are also more abundant during the first half of the life of the plants than during the latter half.

It is frequently mentioned that maguey and sisal will thrive under conditions of neglect which would be fatal to most other economic plants. This is true to a certain extent, but it is also true that these plants respond very freely to a rational treatment along the above-mentioned lines by giving better results.

THE PLANTATION.

With a very few exceptions maguey and, to a smaller extent, sisal, is grown in the Philippines as an emergency crop of secondary importance. Rice, corn, and other crops are planted on the lowlands where the soil is rich and the supply of water abundant, while maguey is raised in small "patches" along the hillsides or on dry lowlands of poor fertility. These plantings are as a rule scattered over a large area and restricted to localities near the seabeach. Their proximity to salt water is essential as up to the present the retting of the leaves in water is practically the only method used for cleaning the fiber.

Under such conditions, of course, there has been no demand for a large and regular supply of leaves in any one locality, and it has been practically impossible for any one planter to handle

satisfactorily the output of a large plantation. As long as the retting method is used for cleaning the fiber, there can be little hope of increasing the cultivation of maguey and sisal and establishing the industry on a sound basis. A review of the history of the henequen and sisal industries in Mexico, the Bahamas, and other countries where they are now firmly established will show that they remained in a condition similar to the present state of the maguey industry here until the planters adopted systematic and modern methods of cultivation and fiber extraction. A similar progress may be made with our maguey and sisal industry, if the planters employ modern machinery for extracting the fiber. Such machines will clean from 30,000 to 150,000 leaves per day, and in order to render their operation practicable a sufficient supply of the raw material must be available. This can be accomplished only by establishing large plantations or several smaller ones in close proximity.

Whether a planter intends to establish a large plantation which would supply a sufficient quantity of the raw-material to operate a machine, or whether he intends to establish a smaller one and be a member of a community using the same machine, several important matters will require his attention and judgment. The first is the selection of the proper location for the installation of the fiber-extracting machine, which depends to a large extent on the lay of the land. If the land is hilly, it will be more convenient and more economic to install the machinery on the lower level thus avoiding the necessity of transporting the raw material uphill. If the land is level, then the location of the machine should be as near the center of the plantation as possible. The second is the construction of roads through the plantation at regular intervals, along which carts may be taken or trucks run upon suitable rails. These roads are necessary in order to facilitate the transportation of the raw material, for it must be borne in mind that for every ton of fiber produced 25 to 35 tons of raw material must be transported to the machine and almost an equal quantity in the form of waste must be hauled away and distributed among the plants for fertilizer purposes. This also emphasizes the importance of laying out the roads at such intervals as would reduce to a minimum the distance to which the bundles of leaves must be carried by hand to the cart or truck. On hilly land the roads must of necessity follow the contour of the land. The third is the importance of systematic planting in accordance with directions given under the chapter on "Planting."

Figure 1 is here given to illustrate the arrangement of a maguey and sisal plantation, whether it be large or small. It represents a section of a plantation which is 50 meters square, or one-fourth of a hectare in area. The plants are set out 1.75 meters apart in the row, with the rows 3 meters apart, thus giving approximately 2,000 plants to the hectare. A road 4½ meters wide is laid out after every 25 rows, limiting to 22½

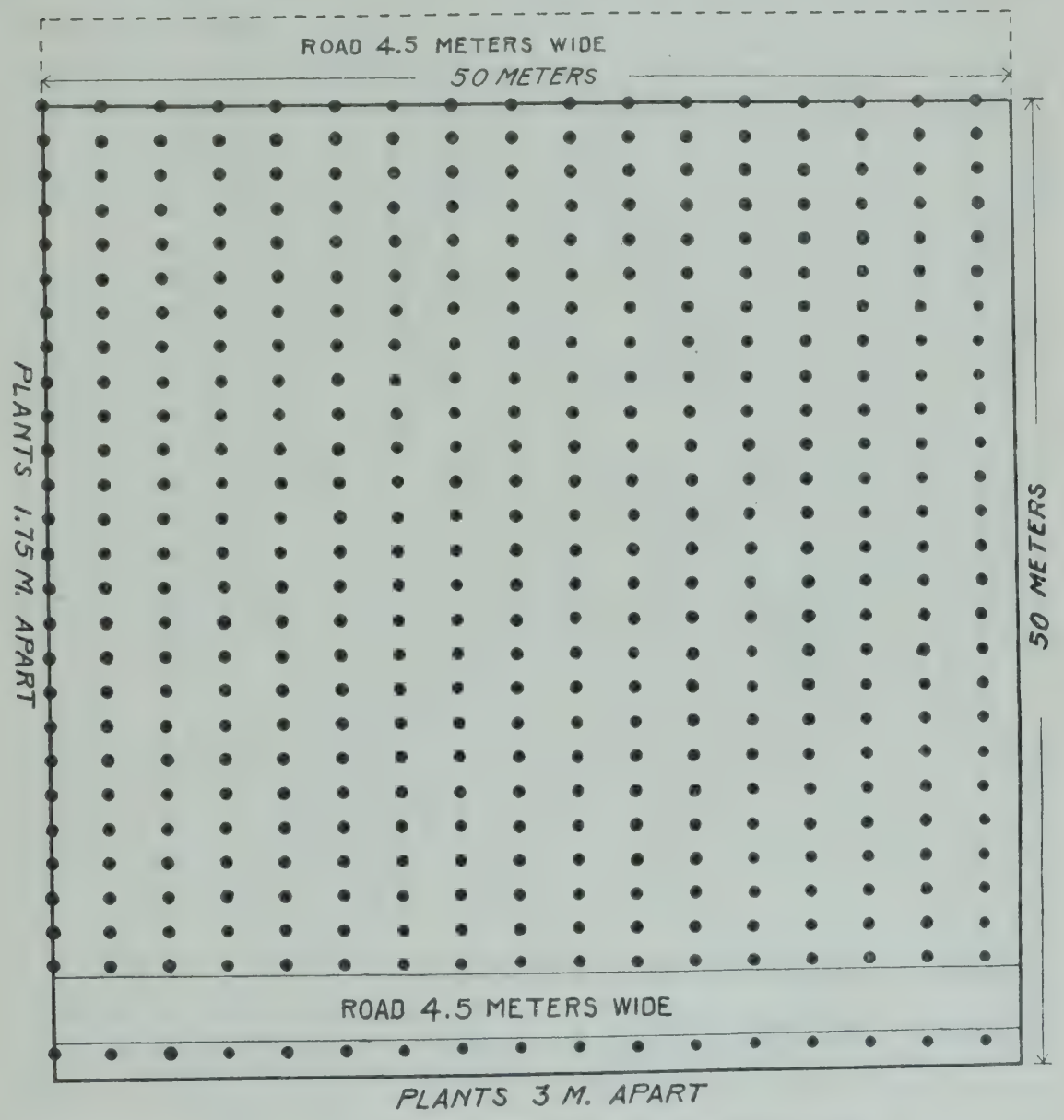


Fig. 1. Plan showing method of planting maguey or sisal.

meters the maximum distance to which the bundles of leaves are carried by hand. These roads, however, may be laid out at greater or less intervals, if in the judgment of the planter this appears to be desirable. Other important problems pertaining to the arrangement and management of the plantation often confront the planter but the nature of these problems and their solution can not be given here, for they are mostly or

entirely governed by local conditions which differ in different localities.

HARVESTING.

The fiber is obtained from the leaves and forms the most essential element in their organic structure. The fiber is of course found in the leaves at all ages, but its complete development is obtained only in mature leaves. As some leaves mature and become unable to perform their function, others are formed to replace them. To remove the fully matured leaves, therefore, does not in any way interfere with the welfare of the plant; on the contrary, it appears to accelerate its tendency to form new leaves. This fact explains why regularly harvested plants generally live longer than those which are neglected.

The age of the plant at which the first crop of mature leaves can be harvested depends to some extent on the soil and climate, and also upon the method of propagation. Under normal conditions here in the Philippines the maguey plant can usually be harvested at the middle or end of the third year from planting, while the sisal plant takes six months to one year longer. If the plants are reproduced from bulbils, both maguey and sisal will require nine months to one year longer to produce the first harvest of leaves than when they are reproduced from suckers. The same variation is also influenced by the age and size of the suckers when these are used for propagation.

Usually only the two outer rows of leaves, which consist of from 20 to 30 leaves, can be harvested annually from one plant. The cutting should commence at the beginning of the dry season; and in case there are two dry seasons in the year, two harvests can be gathered, providing not more than 10 or 15 leaves are removed from one plant at one time. The cutting should be made with a sharp knife at a little distance from the stem, care being taken not to break the leaf or injure the stem during the operation. The marginal and terminal (with sisal only the latter) spines should then be trimmed off to facilitate the handling and transportation of the leaves.

Under no circumstances should immature leaves be harvested, either from young or from old plants. It is extremely unfortunate that this ruinous practice is frequently resorted to by the Filipino planter, presumably for immediate benefit. This practice naturally obstructs the development of the plants and tends to shorten their lives by inducing early maturity. Moreover, the

fiber obtained from such immature leaves is of inferior quality, owing to its incomplete development.

EXTRACTION OF FIBER.

Retting Method.—There are two methods used in extracting the maguey and sisal fibers. The first, which is generally used here in the Philippines, is the "retting" method, by which the leaves are slit into strips, tied in bundles, and immersed in salt water. The bundles remain in the tidewater from six to eight days, during which period they are turned over a number of times so that a uniform decomposition of the pulp may be obtained. When the leaves are sufficiently decomposed they are taken out of the water and the pulp is easily beaten or scraped off. Sometimes the leaves are macerated and left until fermentation has taken place, when the pulp can be easily separated from the fiber. Both these methods, besides being tedious and laborious in the extreme, result in the production of a weak and discolored fiber.

Machinery.—During the last decade or two the fiber produced by the henequen species of Mexico, and also that produced by any of the other two allied species which are grown commercially in other countries, have been almost exclusively cleaned by machinery. The first machine invented for the purpose was the apparatus commonly known as the "raspador," which consists of a 54-inch wheel revolving inside a heavy wooden or metal case. Across the surface of this wheel are placed blunt brass knives, about 20 centimeters or more apart. In front of the wheel is adjusted a concave block, or brass shoe, against which the leaves are scraped by the blades of the former. In most raspadores the concave block can be so adjusted as to subject leaves of any thickness to the scraping knives. The leaves are fed in through a hole in the case. Usually one-half of the leaf, from the middle to the tip, is fed in first; and, when this is cleaned, the leaf is reversed and the remaining half is fed and cleaned in the same way.

All of the medium and large-sized machines, which have recently superseded the raspador on all large plantations, are constructed on the same general principle as the latter. In most of the medium-sized machines, which range in capacity from 10 thousand to 30 thousand leaves per day, each leaf is fed in twice before it is entirely cleaned, thus doubling the time and causing

a considerable waste of fiber. In the large machines, which vary in capacity from 40 thousand to 200 thousand leaves per day, this defect is rectified and the leaves are automatically fed in and cleaned with one operation. These machines perform their work at a considerably less cost than the smaller ones, and their operation is coming into more general use. These machines have also encouraged the cultivation of henequen and sisal on a much larger scale than heretofore, and have also rendered possible the use of large trucks and tramways for transporting the leaves and disposing of the waste.

While it is not to be expected that the retting method will be immediately or entirely superseded by the use of automatic machines, it is hoped that attempts will be made by the progressive class of producers to so arrange and manage their plantation as to render the use of at least the medium-sized machines practicable. The advantages which will undoubtedly accrue from the use of such machinery, providing it is properly and intelligently handled, will encourage the establishment of larger and more systematically managed plantations, which will in turn make possible the use of the larger and more economical machines in the near future.

DRYING AND BALING.

The maguey and sisal fiber, after having been cleaned by the retting method, should be washed with fresh water prior to drying, in order to remove any traces of salt that may remain. The salt absorbs moisture and, even after it has been once dried, will become wet again. If baled in a wet condition, the quality of the fiber will considerably deteriorate, if indeed it does not sometimes actually rot.

The machine-cleaned fiber as it comes out of the machine often has a green tinge to it, due to the presence of traces of the pulp. This green color disappears after the fiber has been thoroughly dried in the sun or washed in running fresh water. The washing of the fiber should not last more than a few minutes, for, if it is allowed to soak, its commercial quality will be impaired. The fiber should not be exposed to rain or dew, or it will lose its luster. Sheds should always be available, in which the fiber should be spread on lines during damp or rainy days.

Before baling, the dried fiber should be made into bundles not more than 10 to 12 centimeters in diameter, and tied near the butt end with a strand. The strands should be as small as it is



Seven-year-old sisal plant, Singalong, Manila.



A three-year-old maguey (cantala) plant, San Miguel, Tarlac.



Maguey (cantala) plant at the "poling" stage.



Branch of sisal "pole," showing formation of bulbils, Singalong, Manila.



(*a*) Three-year-old maguey plantation, San Miguel, Tarlac, showing construction of roads at regular intervals.



(*b*) Maguey plant attacked by a fungous disease.

possible to make them and just strong enough to hold the bundle together, thus reducing to a minimum the loss in cutting and throwing them away as waste at the mill. These bundles should then be so arranged in the bale as to have the butts of one layer alternating with the tips of another. If the fiber is too long, however, it may be bent over toward the tip end, but not in the middle. In any case the fiber in the bundle should under no circumstances be twisted around in a spiral form or in a manner similar to the strands of a rope, for when it is pressed in this form in the bale for several months there will be an unnecessary waste in opening it at the mill and passing it through the carding machinery.

The fiber obtained from the first harvest of the maguey and sisal leaves is always of a much poorer quality than that obtained from subsequent harvests. This is due to the fact that the first and oldest leaves are somewhat dried up, and are always shorter and more damaged than subsequent ones. The first crop, therefore, is by no means a fair sample of subsequent crops, and it should be baled separately and so marked as to prevent any prejudice against future crops on the part of the manufacturers.

YIELD AND VALUE.

The yield of maguey and sisal from a given area depends upon the soil and climate, the distance the plants are set apart, the amount of care and cultivation given the plants, and the method of harvesting the leaves. Overcutting and early cutting always result in a decrease in the yield of subsequent crops.

It is generally estimated that 1,000 mature leaves of maguey or sisal of average size yield from 18 to 22 kilos of dry fiber. It is also estimated that every plant of a normal condition of growth will yield annually an average of 25 to 30 leaves. Allowing 2,000 plants to the hectare with an average yield of 25 leaves each and 20 kilos of dry fiber to every thousand leaves, a hectare planted in maguey or sisal should yield annually 50 thousand leaves producing 1,000 kilos of dry fiber, or one metric ton. The actual quantity of fiber in the mature leaf ranges from $4\frac{1}{2}$ to 6 per cent of its total weight. Of this quantity of fiber, however, a certain portion goes to waste during the operation of fiber cleaning, leaving an average of about $3\frac{1}{2}$ or 4 per cent of commercial fiber. By the retting method less fiber is wasted than by machinery, but the superior quality of the latter much more than makes up for the slight difference in yield.

The value of both sisal and maguey in the world's market today is somewhat above the normal. The quotations on German East African sisal during February of this year ranged from ₱330 to ₱335 per ton. The value of maguey, however, was somewhat less than sisal, ranging from ₱300 to ₱310 per ton for Cebu No. 1 and from ₱290 to ₱295 for Manila No. 1. This difference in value between sisal and maguey is due to the fact that the latter is cleaned by retting and the former by machinery. If maguey were prepared by machinery, its value would be as high as, and probably higher than, sisal.

The price of retted maguey in the Manila market during the same month was about 21 centavos per kilo for Manila No. 1 and about 23 centavos per kilo for Cebu No. 1. If the same fiber had been cleaned by machinery, its value should have been as high as 28 centavos per kilo in the Manila market. Basing our estimates at between 20 to 25 centavos per kilo as the normal value for machine-cleaned fiber in the Manila market, the gross revenue from land cultivated to maguey or sisal should be between ₱200 and ₱250 per hectare annually.

USES.

The principal use to which the so-called sisal fibers of commerce are put is the manufacture of binder twine. Of an estimated annual production of about 140,000 tons of sisal, over 110,000 tons, or about 80 per cent, are henequen from Mexico, and the remainder is sisal and maguey from several other tropical countries, including the Philippines. The bulk of henequen is cleaned by machinery, and is used for binder twine. Sisal and maguey, when cleaned in the same way, are usually considered too good for binder twine and are then used to better advantage in certain grades of cordage. When they are cleaned by the retting method, however, they are usually considered too poor even for binder twine, and they are then used as a mixture with henequen or the low grades of abacá in making the low-grade binder twine.

ENEMIES AND DISEASES.

Maguey and sisal in the Philippines are seldom attacked by any serious disease or insect pest. During the last year or two, investigations by the fiber division of this Bureau have resulted in the discovery of two fungous diseases and one insect pest, none of which is common or of a serious nature. A study of the nature of these fungous diseases is at present being made

by the Bureaus of Science and Agriculture, for the purpose of identifying them and devising effective remedies for their control, in case they spread to any serious extent in the future. In the meantime the planters should watch their plantations carefully for the appearance of any such diseases, as these can be much more easily checked in the beginning than after they have become widespread.

A scale insect known as *Aspidiotus orientalis* Nwst. was discovered some time ago by the writer on the leaves of maguey and sisal at the Lamao experiment station. This, however, can easily be checked by harvesting or cutting off the attacked leaves as soon as it makes its appearance on them. It does not spread rapidly from one plant to another nor does it injure the leaves unless it is allowed to remain on them for a long time. So far, therefore, it has not been found necessary to use lime sulphur or oily or soap washes to check it, as is being done with other scales.

Goats and cattle, especially the former, will inflict considerable damage on the maguey and sisal plants. While it may not be necessary to construct secure fences around the plantation, some kind of vigilance against the entrance of such animals will, in some cases, be necessary.

CONCLUSION.

In certain parts of the Philippine Islands, such as Ilocos Norte, Ilocos Sur, La Union, Cebu, Bohol, and Siquijor, extensive areas of land are found where the soil is too rocky or too poor for the cultivation of any of the principal crops. In these sections, as a rule, there is a scarcity of work animals and an abundance of available labor; this labor at certain seasons migrates to neighboring islands and provinces to assist in the gathering of the harvests there. In the provinces where such conditions exist, there is an urgent need for the introduction of some crop that can be profitably grown. Maguey and sisal answer all these requirements, and while the former, and to a smaller extent the latter, are and have for some time been grown there for their fiber, yet their cultivation is carried on on a very small scale and by careless and antique methods. It is safe to state that under such conditions the material development of these provinces and islands will depend more on the proper establishment of the maguey and sisal industry than on any other single crop or combination of crops that can be raised in them.

The establishment of this industry on a satisfactory basis will require three distinct lines of improvement over the present

methods now in vogue, viz, the practice of proper and systematic methods of planting and harvesting, the necessity of establishing large plantations, or a number of smaller ones in close proximity, and the introduction of fiber-extracting machinery. Systematic planting will lessen the cost of cultivation and harvesting, careful harvesting will increase the yield of fiber and lengthen the life of the plants, and cleaning by machines will considerably improve the quality and value of the fiber.

It is hoped that these lines of improvement have been sufficiently explained in this circular, and that hereafter better and more improved methods will be used to replace the present crude and wasteful methods practised by the majority of the maguey and sisal planters in the Philippines.

ADDITIONAL NOTES ON ROSELLE.[1]

By P. J. WESTER, *Horticulturist.*

It is now some years since the writer first called attention to the fact that the leaves and stems of the roselle could be utilized in the manufacture of jelly and similar products, and experiments were started by him in 1910 in Miami, Fla., under the auspices of the United States Department of Agriculture, to ascertain cost of production and yield of herbage and to obtain data relative to the conversion of the raw material into a manufactured product. Owing to the writer's serious illness during the summer of that year and his subsequent transfer to Washington, D. C., these experiments were not completed. The project had been kept in mind, nevertheless, and shortly after the introduction of the roselle into the Philippines in 1911, an abundant supply of seed being available for the work, an experimental plat was set aside at the Lamao experiment station (in 1912) and planted with roselle.

The land selected for the trial consisted of a stiff loam, well drained, rather below the average Philippine soil in fertility. No fertilizer was applied.

After being irrigated, the land was plowed, disked, and harrowed and the seed sown March 1 in drills 60 centimeters apart. The subsequent cultivation consisted of occasional hoeings to keep down the weeds and to supply an earth mulch to reduce soil evaporation. The land was irrigated whenever necessary until the advent of the rainy season, when this was discontinued. By this time the plants occupied the land so well that no further cultivation was needed. Because of lack of suitable modern machinery the labor item was excessively high; the figures are not given as they would be misleading. For instance, the harvesting of the plants was accomplished by cutting the plants with machetes (bolos). By the use of modern cultivators and harvesting machinery the cost of growing and harvesting roselle herbage would be about that of any ordinary field crop such as maize or cotton.

[1] For a full discussion of the roselle and its culture, see Vol. V, No. 3, 1912, of this REVIEW.

By April 10, the date of the first cutting, the plants averaged 50 centimeters in height and a few had blossomed and set fruit. The yield of herbage was 3,900 kilos per hectare. The plants had been cut from 6 to 10 centimeters above the ground and the weeds were now hoed out between the stubble and the land irrigated. The stubble promptly sprouted and one month after the first cutting the field was ready for a second. This yielded 4,300 kilos of herbage. A third cutting of 9,000 kilos was made July 2. Two out of every three rows of stubble were then plowed up and the middle space cultivated, thus leaving the old rows of plants 1.8 meters apart. Again the plants started to grow and were now allowed to blossom and fruit.

The first harvest of 2,120 kilos of calyces was made October 31. The second harvest, November 14, yielded 2,300 kilos, the third, December 11, 1,800 kilos. A small fourth gathering in January was unrecorded. The total yield in round figures was 17 tons of herbage and 6 tons of calyces. If grown for the calyces alone, experiments in Florida and Hawaii indicate that an annual crop of more than 6 tons of "fruit" per hectare may be expected.

The writer had made jelly and flavoring sirups from the herbage in Florida, and while the product obtained was inferior in color to that made from the calyces alone, it was very good, and the wholesale and economical way in which the products could be made from the entire plant as compared with similar products made from the calyces or other fruits led him to favor this mode of utilizing the plant, already of free and vigorous growth and easy culture. Taking into consideration also that sirup and jelly could be made from the tender parts of the plant no less than from the calyces, it was only a step to the inference that the herbage of the plant might also yield wine with proper treatment, and, when in order to obtain reliable figures in regard to the manufacture of products of roselle, raw material was furnished to the Bureau of Science, the writer suggested that an attempt also be made to make wine. The investigations were conducted by Dr. D. S. Pratt of the laboratory of organic chemistry, who gave the result in an interesting article recently published.[1]

The following table of analyses of roselle calyces grown in Florida and the Philippines and of the cranberry is quoted from the paper by Dr. Pratt for comparison.

[1] Philippine Journal of Science (1912), Sec A, No. 3, pp. 201–205.

Analyses of roselle and cranberry.

Constituents.	Florida roselle.	Philippine roselle.	Cranberry.
Water	88.91	82.49	88.53
Solids	11.09	17.51	11.47
Ash	.89	1.26	.25
Marc (insoluble matter)	6.67	7.39	4.60
Acid as malic	2.77	3.31	2.74
Reducing sugar as invert	.33	.82	1.90
Sucrose	.03	.24	.10
Benzoic acid	Absent.	Absent.	Present.

It is interesting to note that the Philippine-grown roselle is considerably superior to that grown in Florida both in acid and sugar content.

The following is quoted verbatim from the same paper:

Roselle owes its pleasant acidity entirely to dextro-malic acid. This is not confined to the calyx alone, but is distributed throughout the plant. The leaves contain about 1.25 per cent and the stems about 0.6 per cent, depending upon their age and location. The stems also contain some coloring matter. It appears from these analyses that both stems and leaves contain sufficient flavoring material to render them suitable for use in connection with the calyces except where it is desired to obtain a brillantly colored jelly or jam.

A comprehensive examination was made of roselle with reference to its adaptability as a source of flavoring sirup and of a beverage resembling wine. In both of these cases it is not essential to obtain a bright red product and the great advantage of utilizing the entire plant made it worth while to experiment on this basis. The cost of the product is lower and the manufacture much more simple than in the other case where each calyx must be gathered separately. Needless to say, a finer-grade product, with better color and flavor, may be obtained from the calyces alone. This is a matter of personal choice. As the procedure is similar in both cases, only that utilizing the entire plant need be given in detail.

ROSELLE SIRUP.

The flavoring sirup may be made according to the following directions, which may be modified to suit the individual taste. The plant should be harvested while still of moderate growth, with tender stems and at least half-matured calyces. While perfectly fresh, chop the entire plant into lengths of about 10 centimeters and pack in a keg or earthenware jar. Metal containers are attacked by the acid, and are not to be used at any stage of the process. Pour in sufficient boiling water to cover the plants, and then cover the keg to exclude dirt and molds as much as possible. Allow this to stand two or three days to extract the soluble material, then filter through muslin or other suitable cloth. This gives a red liquid with a strong acid taste and pleasant fruity smell. Boil this liquid in an enameled dish until it reaches about one-third its original volume and add sucrose to suit the taste. About equal volumes of sugar and concentrated

juice will usually be satisfactory. Continue the boiling with constant stirring until the sugar is completely dissolved, and bottle while hot. If desired, the juice of a lime may be added to each liter of sirup. The resulting sirup has a very attractive taste and makes a refreshing product when added to water, or used as a basis for sherbets, water ices and soda water.

ROSELLE WINE.

Roselle wine may also be made from the entire plant, although here again a product with richer color and better flavor results from using only the calyces. The plant is cut and treated as in making the sirup. After filtering through cloth, the juice is placed in a clean cask previously scalded out with boiling water. For every 4 liters of juice use 1 kilo of sucrose made into a thick sirup with boiling water and poured into the juice. Suspend yeast in warm water, add this to the contents of the keg and mix thoroughly by stirring. The keg should now be carefully covered, or if one with the ends on has been used the bung may be stopped with loose cotton. To obtain a good wine foreign ferments should be excluded. The cask is then put aside and allowed to remain undisturbed during fermentation. Within a week this will near completion. If a sparkling wine is desired, the juice is racked off before fermentation has stopped and stored in bottles with corks securely wired to prevent expulsion. If a still wine is to be made, the bottling is delayed until fermentation has ceased. Age will improve the flavor and bouquet, but the young wine is very attractive in taste and appearance. As made from the entire plant, it has a light reddish color and a sweet refreshing taste.

The still wine made from the herbage analyzed 8.8 per cent alcohol, 13.68 per cent invert sugar, and 1.05 per cent sucrose.

The roselle material employed by Dr. Pratt in his experiments was from the earliest cutting referred to above, and for this reason the young plants had a few partly grown calyces; the subsequent cuttings carried no calyces and in fact repeated cuttings during the summer could never have any for the reason that the plant does not blossom until September and October. From his experience with jelly and sirup of the plant the writer does not believe that the presence of calyces is essential; however, when present as part of the raw material, they tend to improve the color of the product.

It is, of course, not anticipated that roselle wine will ever compete with the better classes of wine, but it would undoubtedly serve a useful purpose as a cheap and good wine for those who consume the poisonous adulterated article that is now sold in such large quantities.

About 100 kilos of herbage and 75 kilos of sugar make 300 liters of wine, while an equal amount of herbage furnishes approximately 200 liters of sirup, depending upon the quality of the herbage at the time of the cutting. If the material is tender

and succulent less is required to make a given amount of the finished product than if it is overripe and fibrous.

According to Mr. Higgins of the Hawaii Agricultural Experiment Station, about 4 kilos of calyces and 1.8 kilos of sugar are required to make 1 dozen 6-ounce jars of jelly.

In considering the possible profits in growing roselle and manufacturing it into various products, the price of local labor should of course be taken into consideration in connection with the figures quoted above. It should also be remembered that well-flavored and attractive though the products may be they are at present practically unknown in the world's markets and that the expense of judicious advertising would probably be necessary in order to introduce them.

During 1912 several new varieties of roselle were introduced into the Philippines and tested at the Lamao and Singalong experiment stations. Only one of these has approached in quality and yield the previously introduced varieties "Victor" and "Rico." The Rico showed more vigor and resistance than any other kind to a fungus that more or less seriously injured the other varieties.

Two varieties imported from the Gold Coast, West Africa, are remarkably distinct from any other variety that has hitherto come to the attention of the writer. One is a red form and the other intermediate between the green and red types; both are of remarkably vigorous growth, of upright habit, not bushy, and frequently exceeding 3.5 meters in height. The calyces are small, closely fitting the seedpod and thickly covered with short stiff bristles. Both these varieties are useless from a culinary point of view; they may, however, be of value for their fiber.

THE COCONUT LEAF-MINER BEETLE.

(*Promecotheca cumingii* Baly.)

By CHARLES R. JONES, *Entomologist.*

The coconut tree (*Cocos nucifera* L.) is attacked by a comparatively small number of insects but the damage received from the ravages of these insects is rather large as compared with the insect injury to some of the other crops of the Philippines. The coconut has several insect enemies that feed extensively upon the trunk and leaves and in seasons favorable to insect development the increased damage means considerable loss to the grower.

The most comprehensive work on coconut insects of the Philippines was published by the Bureau of Science,[1] treating them as two classes, i. e., those that attack the trunk and those that attack the leaves. The coconut number of the PHILIPPINE AGRICULTURAL REVIEW [2] also contains a chapter on "Insect Enemies of the Coconut." The department of agriculture of New South Wales [3] and the board of agriculture of Trinidad and Tobago [4] have each issued a publication which treats extensively of coconut insects, but none of the papers named records the abovementioned species which in both the larval and adult stages feeds upon the leaves of the young coconut. As yet the writer has not found the old palms to be attacked by this pest, and in all probability they are very seldom injured by this insect.

The object of the present paper is to give briefly the life history and habits of this insect with methods for its control.

This beetle belongs to the subfamily *Hispidæ*, of the Chrysomelidæ family, which contains our worst leaf-eating beetles, and is distributed generally throughout these Islands. There is but little doubt that it, or representatives of this family,

[1] The Principal Insects Attacking the Coconut Palm, Philippine Journal of Science, 1906, Vol. I, Nos. 2 and 3.

[2] Insect Enemies of Coconuts, Philippine Agricultural Review (1912), Vol. V, No. 5, 254–261, 5 pls.

[3] Pests and Diseases of the Coconut Palm, Department of Agriculture, New South Wales, Science Bulletin (1912), No. 2, 1–47, Figs. 10, pls. VII.

[4] Preliminary Notes on Some Insects Affecting the Coconut Palm, Board of Agriculture, Trinidad and Tobago (1911), Circular 5, 1–26, pls. III.

occur in all coconut-growing countries; in fact, Mr. W. W. Froggott [5] reports a representative of this subfamily as being the most serious coconut pest of the Solomon Islands.

LIFE HISTORY.

Egg.—The egg (fig. 2, *a*) of *Promecotheca cumingii* is deposited singly on the under side of the leaflets and generally on the lower leaves of the young palms. The beetle eats a small hole through the lower epidermis of the leaf, leaving the edges very rough. The egg is then inserted in this hole, and cemented into place with a yellowish glutinous secretion which turns



Fig. 2. Coconut leaf-miner (*Promecotheca cumingii* Baly). (*a*) Egg on leaflet; (*b*) larva; (*c*) pupa; (*d*) adult.

dark brown upon hardening, and resembles the dried leaf tissue. In some cases the adult was observed, after the egg had been cemented into place, to pat it with her front feet, but usually, after resting a few seconds over the egg, she moves away and resumes feeding.

The eggs are flat, semielliptical, brownish bodies shaped somewhat like a pumpkin seed; the outer surface or covering is very rough, and the eggs are very easily broken when this protective substance is removed. Their length is 1.5 milli-

[5] Science Bulletin No. 2, New South Wales, 24, 26.

meters; width, 1 millimeter; thickness, 0.3 millimeter. The period of incubation (of 286 eggs) averaged 13.5 days, the maximum being fifteen and the minimum thirteen days.

Larva.—Upon hatching, the larvæ (fig. 2, *b*) eat their way through the egg wall and directly into the tissue of the leaflet where they spend the entire larval and pupal stages and are protected to some extent by the lower and upper epidermis of the leaflet. They are fleshy footless grubs and average about 1.2 millimeters in length when newly hatched. The head is larger than the following segment, wedge-shaped, shiny brown, translucent and has rounded sides; the mandibles are black and can be drawn under the labrum. Two brownish lines form an X on the back of the head. Two whitish bodies extending under the head near apex give the appearance of an arrow head. These markings are absent in latter stages. In older larvæ the head is slightly smaller than the following segment; body yellowish cream color, semicylindrical, tapering from segments 1 to 11, and anal segment being about one-half the size of segment 1. Segment 1 depressed anteriorly, segments 1 to 11 protruded into tubercles on both sides which give rise to setæ of six hairs each.

Average length of full-grown larvæ, 9.54 millimeters; average width of head cast, 1.54 millimeters. The average time required in the larval stage is 32 days. Twenty-eight of these are spent in feeding and developing and four days are spent without feeding in which time the larva changes into a pupa. During the development of the larva it feeds upon the parenchyma of the coconut leaf and at all times, except when molting, it can be found at the end of the chamber farthest from the egg. The larva burrows in one direction only, the old egg shell marking the starting point. When molting and when changing into a pupa it recedes to the center of its chamber. A characteristic habit of the larvæ is the depositing of the excrement in two rows, one on either side of the excavated chamber.

In studying this insect, adults were placed in gauze bags which were tied over the leaflets of the palms. These insects were removed daily to fresh leaves and the leaflets containing the eggs were tagged but still kept in the gauze sacks to keep out possible parasites. Daily observations were made on these eggs for hatching and the larvæ were examined every two days for molts.

After opening the larval chamber the leaf curled and dried and the larva in most cases died, or its development was greatly retarded; therefore it was necessary to take four larvæ of the

same age for each day's observations. In no case were more than two molts observed; the exact number of molts has not been definitely established, owing to the difficulty in observing this insect.

Pupa.—After the larva is full-grown, as stated above, it retires to the center of the chamber and here without forming any pupal cell, undergoes the transformation into pupa and adult. The average time occupied in the pupal stage is 7.3 days, the maximum period noted being 12 and the minimum 5 days.

The pupa (fig. 2, *c*) is of a chrome-orange or burnt-sienna color; hairy; head smaller than thorax; eyes black; mandibles brown; the anterior tarsi held together. There are two rows of black transverse spines on each segment, the anterior row consisting of six spines. The average width is 1.6, and the length 8.1 millimeters.

Adult.—The beetles (fig. 2, *d*) vary from 7.5 to 10 millimeters in length, exclusive of the antennæ and from 1.6 to 2 millimeters in width. The thorax is much narrower than the slender body. General color brown ochre, head small, eyes and mandibles black, elytra finely punctate in parallel furrows. Antennæ 11 jointed, tarsi broad and flat, one larger spine on inner side of each femur with a corresponding depression on the tibia. The body is pilose.

The beetles are sluggish and do not fly readily upon being disturbed. They rest by clinging lightly to the under side of the leaf with the antennæ extended forward close to the leaf. They crawl about promiscuously on the leaves of the young coconut and feed extensively upon the tissues between the veins of the leaflets. The injury has the appearance of a slight cut but does not entirely penetrate the leaf (Plate VII, *a*).

The damage done by the larva is greater than that by the adult, as a single larva will excavate a place in the leaf from 12 to 16 millimeters long and 1½ to 3 millimeters wide (Plate VII, *b*). The tissue attacked soon dies and becomes brown, and in badly infested areas the numerous dead leaflets give the palm the appearance of being unhealthy or half dead; where the trees are used for decoration this effect is very displeasing. The palm is also injured by the loss of these leaflets.

LIFE HISTORY SUMMARY.

The eggs are inserted by the female beetles just beneath the epidermis of the leaf. They are deposited singly, and hatch in from 13 to 15 days. The period of incubation varies but little. The larvæ upon hatching enter the parenchyma of the

leaf and here spend the entire larval period, which is about 32 days. They do not form any pupal cell but pupate in the middle of the excavated chamber formed by feeding. The average length of the pupal stage is 7.5 days. The adult after emergence remains from two to four days within the food chamber, before it bursts the epidermis of the leaf and escapes.

CONTROL.

As is the case with many other insects, the coconut leaf-miner undoubtedly has many enemies, both predaceous and parasitic. Two species of *Hymenopterous* parasites of the family Chalcididæ have been bred in great numbers, one from the egg and one from the larva and pupa. These have not yet been identified. In fact, it is probable that these parasites keep this beetle in check, and were it not for them, the leaf-miner would be a most serious pest to the coconut industry.

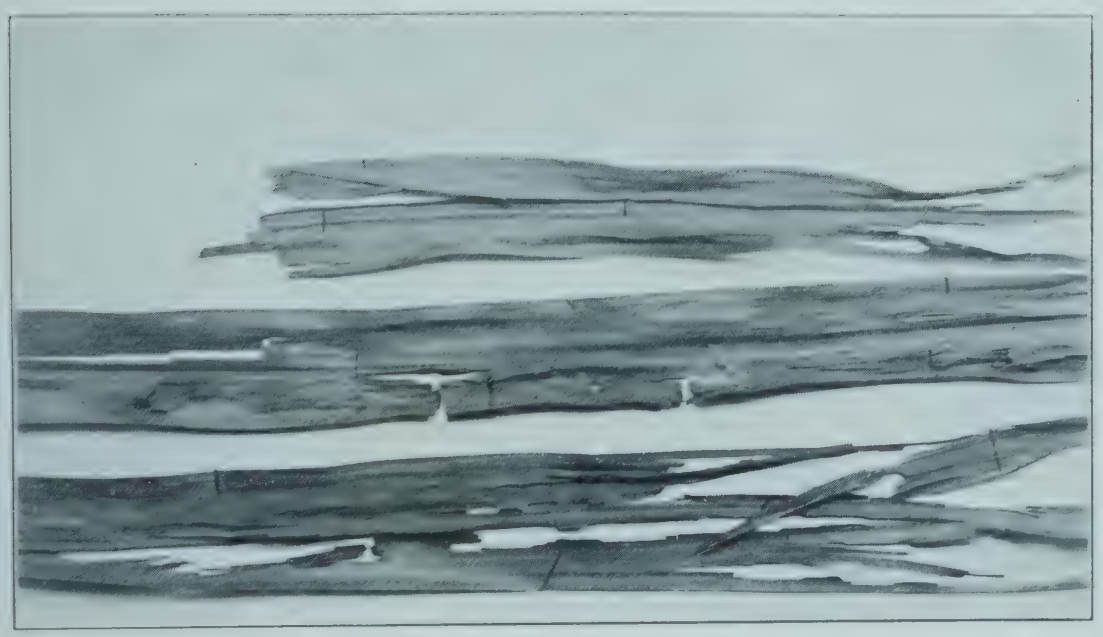
Observations have shown that a little over 44 per cent of the larvæ and pupæ are parasitized by this Chalcidid while egg parasitization averages about 5 per cent. From these two parasites alone the total percentage of mortality is about 50 per cent.

The following table gives the results of the examination of 100 leaflets taken from infested palms on August 3, 1910:

Leaflets examined.	Eggs.	Larvæ and pupæ.	
		Alive.	Dead.
10	23	20	18
10	41	30	11
10	38	23	23
10	25	29	22
10	27	33	35
10	29	21	16
10	30	17	12
10	21	15	6
10	24	15	11
10	13	14	22
100	296	217	176

NOTE.—Leaves taken promiscuously from different palms. No account was kept of previously infested areas, the only record was of places that contained evidences of the presence of the leaf-miner. Percentage of larvæ parasitized, 44.7 Three leaves found free from infestation.

As the eggs, larvæ, and pupæ of the leaf-miner are protected to a greater or less extent within the leaf tissue, hydrocyanic-acid gas, used as a fumigant, would be the only effective insecticide. This method would be recommended only in extreme cases where infestation is very heavy. As the beetles are not very active and are almost invariably on the lower leaves of



(*a*) Leaflets injured by adults.



(*b*) Leaflets injured by larvæ.

Coconut leaflets injured by *Promecotheca cumingii* Baly.

the coconut palms, they can be readily controlled. The infested leaflets are readily recognized and may be easily removed and burned, thus destroying the eggs, larvæ, and pupæ.

Hand picking of the adults and removing of infested leaflets is the simplest remedy, and since it requires no skill, even children can readily do the work.

The above operations if practiced in the infested young groves would be an inexpensive and effective method of control.

THE FIFTH ANNUAL MEETING OF THE PHILIPPINE VETERINARY MEDICAL ASSOCIATION.

By Dr. ALVIN BROERMAN, *Secretary-treasurer.*

The fifth annual meeting of the Philippine Veterinary Medical Association was held in the Young Men's Christian Association Building, Manila, on Friday, February 7, 1913.

The president, Dr. Joseph R. Jefferis, veterinarian, Seventh Cavalry, U. S. Army, called the meeting to order at 9.30 a. m. As the minutes of the last meeting had already been published, it was not considered necessary to have them read before the association.

A short address of welcome was delivered by the Hon. Newton W. Gilbert, Vice-Governor and Secretary of Public Instruction of the Philippine Islands, in which he enumerated the difficulties that the veterinarians in the Bureau of Agriculture are having in enforcing an efficient quarantine against rinderpest throughout the Archipelago. He also stated that the veterinarians occupy a very delicate position which often requires a large amount of diplomacy and his earnest desire is that they try their utmost to gain the confidence of the Filipino people. Dr. Jefferis responded.

Dr. C. H. Decker read a paper on rinderpest in the Amburayan Valley and Dr. J. D. Reardon a paper on rinderpest quarantine in the Province of La Union. They cited their experiences and some of the interesting results obtained in eradicating this disease.

Mr. M. B. Mitzmain, veterinary entomologist, Bureau of Agriculture, read a paper on the entomological factors concerned in the measures required for the control of surra. Mr. Mitzmain is working on the transmission of surra at the Alabang research laboratory and stated that he has found *Tabanus striatus* to be an agent in the transmission of the trypanosomes of surra. This paper stimulated a lively discussion on the various phases of the disease.

Dr. R. W. Newcomb read a paper entitled "Kidney-worm infestation of swine as shown post-mortem at the Manila matadero." The worm (*Stephanurus dentatus*) was found by Dr. Newcomb in 50 per cent of the animals slaughtered.

Dr. W. H. Boynton, pathologist, Bureau of Agriculture, gave a short lecture on the diagnosis of rinderpest by blood examination, illustrating his talk by charts. Dr. Boynton also stated he has found that leeches, after sucking blood, carry the infection for more than three days.

Dr. C. H. Schultz, who read an instructive paper entitled "Observations on the diagnosis of glanders," is also working at the veterinary research laboratory at Alabang.

A report by Dr. C. G. Thomson on the rinderpest campaign on the Island of Panay was read by Dr. Archibald R. Ward, chief veterinarian, Bureau of Agriculture. This gave in detail the methods employed in that district.

Dr. T. T. Hartman prepared a paper on the quarantine and tie-up in the northern district of Iloilo Province. It was impossible for Dr. Hartman to attend the meeting and the paper was read by the secretary.

The meeting then went into business session and the following officers were elected: President, Dr. F. C. Gearhart, chief of the division of animal husbandry, Bureau of Agriculture; vice-president, Dr. A. G. Donovan, veterinarian, First Field Artillery, U. S. Army; secretary-treasurer, Dr. R. W. Newcomb.

It was decided to give a banquet at the Army and Navy Club on the same evening.

The following members of the association were present at the meeting: Drs. A. R. Ward, Joseph Jefferis, A. G. Donovan, A. S. Shealy, Stanton Youngberg, C. H. Leavitt, Lyman Bishop, W. W. Richards, R. W. Newcomb, F. W. Wood, C. H. Schultz, W. H. Boynton, J. A. Thompson, D. W. Shaffer, W. J. Palmer, A. H. Julien, C. H. Decker, J. D. Reardon, W. A. Korb, J. R. Burns, H. F. Hungerford, H. F. Kern, L. W. Fisher, A. M. Meade, J. L. Gross, W. L. Davis, W. K. Howard, W. A. Kliphardt, C. C. Middleton, D. F. Coyner, Victor Buencamino, W. A. Curtis, F. C. Gearhart, and Alvin Broerman. Six visitors attended the meeting.

The meeting was adjourned to convene at the call of the president.

THE RECENT CAMPAIGN AGAINST RINDERPEST ON THE ISLAND OF PANAY.[1]

By C. G. THOMSON, *Supervising Veterinarian.*

In accordance with travel order dated June 10, 1912, I sailed from Manila June 15, arrived at Iloilo June 17, and immediately took charge of the campaign, relieving Dr. F. W. Wood.

Drs. Elliott, Hartman, Ladson, and Palmer have been associated with me in this work, with an average of about 10 American and about 35 Filipino live-stock inspectors.

At the time of my arrival the following forces had been assembled and distributed:

(*a*) Philippine Constabulary: One company, distributed through La Paz.

(*b*) Philippine Scouts: Twenty-fourth Company (Captain Neisser); Twenty-first Company (Lieutenant Strauhm); Thirteenth Company (Captain McElldery); Seventh Company (Lieutenant Vaschon). One-half of the Tenth Company (Lieutenant Rimmer), and all the Forty-ninth Company (Captain Spears), were later made available, and relieved the Constabulary, who were withdrawn from rinderpest duty and returned to barracks. During the last six weeks of the campaign the Seventh Company, which had been withdrawn in August for post duty, was returned to rinderpest service for about a month.

Maj. Hanson Ely organized the Scout rinderpest service, but was ordered to the United States in August and relieved by Maj. Alvord V. P. Anderson, who remained in command of the troops until the work was completed.

The plan of campaign differed but slightly from other Scout campaigns of last year. The most significant departure from former methods lay in the abolishing of intermunicipal quarantines, the infected or suspected barrios alone being guarded against exit of susceptible animals. The infection was so widely scattered through Iloilo and Capiz Provinces, and the physical features of the territory to be covered were such that it was considered inadvisable to attempt at the outset a progressive search of all territory. Instead, a Bureau corps and detach-

[1] Submitted February 4, 1913.

ments of troops were maintained in all known infected areas, and from these centers the surrounding country was worked. Subsequently, as infection subsided, it was possible to concentrate the forces and to effectively cover all of the inhabited portions of Iloilo and Capiz Provinces. The troops were not used in Antique, as the character of its terrain is such as to permit of handling more economically by Bureau forces alone or with Constabulary aid if it becomes necessary.

Census work was pursued as usual by Bureau employees, who completed animal lists for nearly all the towns occupied. The Scouts also did some independent census work. The usual discrepancies with municipal lists were seldom noted as the municipal census averaged only about 10 per cent below that made by the Bureau forces. The municipal officials of Iloilo Province are in unusually close touch with animal conditions.

A request for the use of a small launch was submitted early in the campaign for the purpose of making occasional patrols of the straits, as well as for service in transportation of men and supplies, but no such launch was available. The fear that infection would be carried to Guimaras and Negros proved without foundation, as to the best of my knowledge rinderpest does not exist in either island. Credit for the escape of Negros belongs to my predecessors, who developed an effective port supervision for outgoing animals through utilization of the efficient local customs service. Throughout the campaign susceptible carabaos were held under observation in Iloilo for twenty days, and cattle ten days, pending extraprovincial shipment. Since the apparent eradication of rinderpest from Iloilo Province, these periods of observation for carabaos and cattle have been reduced to ten and five days, respectively, and shipments will be thus handled until the removal of quarantine restrictions imposed by the Honorable the Secretary of Public Instruction.

Every effort was made to acquaint the people with the potential gravity of the situation, to enlist their sympathy and coöperation and to direct their efforts correctly. This was attempted by conferences with influential men, by obtaining the support of the local press, by means of explanatory circulars sent to each planter in the two provinces, etc.

The lack of experienced American inspectors interfered from the outset and unquestionably was costly to the Bureau. No other single factor so seriously handicapped the veterinarians in their work. The American inspectors now on duty in Panay are very satisfactory employees.

There was less delay in organizing a suitable Filipino corps, as several experienced Filipino inspectors were already on the ground and it was not difficult to build up a satisfactory personnel around them. Our present Filipino corps is the most efficient I have known.

The provincial government of Capiz provided 10 Filipino inspectors and is still maintaining this number for service against foot-and-mouth disease. The Province of Iloilo early in the Scout campaign provided 10 men, but owing to lack of funds was obliged to reduce the force to 5 men in October and to discharge these at the end of December.

The work was trying physically to the men, being inaugurated at the beginning of the rainy season. The infected country was rugged and hard to cover, good roads were short and few in number and the trails muddy and crossed by numerous unbridged streams. Owing to the scarcity of ponies on this island most of the traveling was necessarily performed on foot.

As the campaign was initiated at the beginning of the plowing season, there was some complaint against the system of tying up carabaos in infected barrios, but it was possible to issue work passes in all districts in ample time to permit necessary seedbed work, and later for more extensive preparations of fields.

The stimulus afforded to plowing activities in other campaigns was in evidence again in this. Iloilo Province increased her normal rice acreage by 55 per cent, and Capiz Province by 40 per cent. It is regrettable that subsequent losses by typhoons and insect pests materially reduced these anticipated harvests.

A most favorable feature of this campaign was the dispatch with which the quarantine force was made available for duty in Panay. The infection was so scattered that, had it been impossible to throw troops and veterinary corps into the island immediately, it is probable that a most costly outbreak would have developed. It is especially fortunate that of the troops detailed for this district several companies had seen previous rinderpest service in Cebu, Oriental Negros, and Siquijor, were placed in the field immediately by Major Ely, and were able to operate effectively from the outset.

Worthy of note is the almost perfect execution over a wide area of the often attempted "isolation-work" quarantine established in the Pototan district by Dr. T. T. Hartman. He obtained a complete segregation of carabaos by persuading owners to tie each animal on the plot of land the animal was to plow,

building a cheap cover for shade during the midday, and usually securing water by digging a shallow well on the spot. This was accomplished throughout that district. It is a perfect form of quarantine, checks rinderpest automatically, and yet does not interfere with plowing.

Following the completion of the work in Capiz and Iloilo Provinces and the withdrawal of troops from local rinderpest duty in November, Dr. W. J. Palmer, with 3 American and 9 Filipino inspectors was stationed in southern Antique; they have since been conducting a progressive campaign northward, and are now approaching the end of the work. Simultaneously, Dr. H. H. Ladson, with 1 American inspector and 10 provincial-paid Filipinos, has been operating against foot-and-mouth disease, which has obtained a serious hold in Capiz Province. In Iloilo Province Mr. W. H. Brightman with 6 Bureau Filipino inspectors has eradicated the rinderpest and foot-and-mouth disease which developed in Guimbal, and later searched the contiguous territory. Mr. James McIntosh is stationed in Occidental Negros to keep in touch with conditions there. Following the completion of the Antique project I purpose detailing one veterinarian and several inspectors in Negros, with the object of making a reasonably close search of that province for animal disease.

In addition to rinderpest, surra, and foot-and-mouth disease, sarcoptic mange of carabao and infectious lymphangitis have also been encountered in the field during the period with which this report deals, June 1 to December 31, 1912.

During the six months from July to December there was a total of 24 municipalities infected, all developing cases of rinderpest which were verified by post-mortem examination by Bureau employees. These infections were widespread, being distributed as follows: Capiz Province—Lizo, Taft, Malinao, Banga, Panay, Capiz, Panitan, Pontevedra, and Dao; Iloilo Province—Guimbal, Oton, Arevalo, Iloilo, Jaro, Santa Barbara, Pototan, Dumangas, Barotac Nuevo, and Passi; Antique Province—Valderrama, Pandan, San José, and Sibalom.

A glance at the map of Panay will show the extent of the area involved.

The records at hand show a total of 130 animals attacked by rinderpest, 99 deaths and 31 recoveries, a mortality of 76 per cent. These figures are, of course, exclusive of the imported animals handled at the La Paz quarantine station.

The origin of infection is a debatable question. It is reasonably certain that the majority of towns were infected through



Fig. 3. Map of Panay.

shipments of carabaos from the La Paz corrals. Subsequently, during the period of simultaneous inoculation when over a thousand animals were handled in improvised corrals, infection probably escaped into the immediate surrounding area. However, it is difficult to account for the contemporaneous appearance of the disease in isolated towns, such as Pandan, except by the assumption that rinderpest has lurked in remote districts since a time prior to the arrival of the infected Indo-Chinese carabaos. This assumption is justified by the fact that the Bureau had not been able heretofore to maintain a sufficient force in Panay to permit of thorough searching. The assumption of previous infection may also serve to throw light on the varying virulence of the disease in different localities, which reached 100 per cent in some areas and only 10 per cent in others—this among animals of similar breed and approximately like age.

The La Paz center of infection and the history of the distributions of animals from there accounts for the disease along and near the railway and the traveled highways. However, one must adopt the previous infection hypothesis for certain other districts such as Pandan, Valderrama, and the mountain barrios of Guimbal, which are difficult of access and are sources of supply rather than animal markets.

The infection of Iloilo, the rapid spread of rinderpest over so large a territory, and its early recognition by the public as a serious menace to the prosperity of Panay and Negros, aroused a general interest and a degree of coöperation new in my experience. Substantial assistance was rendered the Bureau by various organizations and persons.

Especially deep appreciation is felt for the assistance rendered by several local offices. The Philippine Railway Company, with notable public spirit, furnished free transportation for employees and all materials used in the rinderpest campaign; when the need for inspectors was especially pressing they loaned Mr. Renner to the Bureau for field work. Governor Montinola of Iloilo and treasurer Gracey of Capiz took a keen interest in the work and were especially helpful in tiding over the unpleasant period when the planters feared loss of crops through quarantine restrictions. The attitude of the local press was gratifying throughout.

The Philippine Constabulary assisted in many ways. Detachments were made available for quarantine service whenever requested; circulars of instruction were given to each soldier, outlining briefly the simple facts concerning rinderpest, so that in patroling they could intelligently gather information relative

to that disease and act thereon. As in their routine patrols they regularly cover every place on the island, their utilization was a considerable asset. The Constabulary also rendered aid of a confidential nature.

The Philippine Scouts were, as in other similar campaigns, of inestimable value. Without their assistance or that of a similar arm, little could have been accomplished.

Following is a chart showing, by weeks, the recorded deaths, etc., during the period from June 9 to December 28, 1912:

Week ending—	Provinces infected.	Towns infected.	Barrios infected.	New cases.	Deaths.
1912.					
June 9	Iloilo	5	16	13	10
15	do	8	15	15	6
22	do	7	20	6	12
29	Iloilo and Capiz	7	10	4	8
July 6	do	10	17	9	4
13	do	10	17	10	2
20	Iloilo and Antique	8	12	10	6
27	Iloilo	6	9	1	5
Aug. 3	do	8	10	8	7
10	Iloilo and Antique	8	11	4	1
17	do	7	10	3	2
24	do	7	10	2	4
31	Iloilo, Antique, and Capiz	8	13	8	5
Sep. 7	do	5	10	7	3
14	Antique and Capiz	8	13	8	4
21	do	8	14	4	5
28	Capiz	7	13	1	0
Oct. 5	do	6	12	1	0
12	do	5	11	0	1
19	Antique and Capiz	3	3	4	4
26	do	3	3	0	0
Nov. 2	Capiz (no report from Antique)	1	1	1	1
9	Antique and Capiz	2	2	0	0
16	Capiz (no report from Antique)	1	1	0	0
23	Capiz	1	1	0	0
30		0	0	0	0
Dec. 7	Iloilo and Antique	3	3	7	7
14	do	3	4	2	1
21	do	3	5	2	1
28	do	3	5	0	0
Total				130	99

CURRENT NOTES—MAY.

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

MANCHURIAN BEANS.

It is almost inconceivable that in the brief period during which European commerce has taken note of North China beans there should have been built up a trade amounting to no less than from 60 to 75 million pesos per annum. In a country by no means famous for its soil richness nor its transportation facilities there has been established a first-class industry in which the profits are very large in proportion to the capital employed. It just happened that the climate and the soil were unusually well adapted to the soya and broadbean culture.

Gauged largely by the demand for oil and bean cake in Europe and the amount of available cheap freight transportation, this bean crop will increase and probably more and more influence the Philippine copra and coconut-oil trade. Strangely enough this legume crop, which one would think could have no possible connection with palm nuts, does throw a very vast amount of cheap oil into the world's markets and the cake from the oil presses does compete with poonac, or copra cake, as a cattle feed. Briefly then, good weather in Manchuria or better commercial outlets for the bean crop of that country affect the profits of the Philippine coconut grower almost immediately.

BURMA CROPS.

Peanuts are slowly but surely coming to the front in Burma according to consular reports. The area in this crop now under cultivation in that country is nearly 70 thousand hectares and the present crop is estimated at some 67 thousand tons. This crop also affects the value of copra oil.

The rice crop of Burma is approximately $2\frac{1}{2}$ million tons. The area under cultivation is gradually increasing and now amounts to considerably over 3 million hectares. The present reported area cultivated to rice in the Philippines is 1,120,000 hectares.

AUSTRALIAN MEATS.

The experiment of exporting meat from Australia to San Francisco and Hawaii is now being made. When we remember the wonderful facilities both in the way of very cheap production and in the tremendous advantages of modern systems of shipboard refrigeration, it is to be expected that the agricultural districts of the United States would better go in for high crop yields and buy their meats with a (small) portion of the profits therefrom.

COCONUT AND COCOA.

The world is consuming hundreds of tons of coconut "butter" daily. We are also using one way and another very large amounts of cocoa butter, which is translated cacao tallow. This tallow, made as a by-product in chocolate manufacture, is a very highly nutritious food in itself and a sort of flavoring "filler" for many sorts of confectionery, etc. It is also extensively used by the medical profession.

While formerly it was considered of not much value, largely on account of its use being hardly understood, it is now worth more than the product itself, something like ₱2 a kilo. Unfortunately the British, and to some extent the American, manufacturers persist in using this old-fashioned and more or less execrable word "cocoa" instead of cacao. Not only in resemblance of words, then, but actually in commerce, do these two comparatively new vegetable "butters" stand as rivals.

VENEZUELAN COCONUT FACTORIES.

We learn from the Daily Consular and Trade Reports that a new coconut plant is being established near Cumaná to handle direct coconut products. It is believed that 30 to 40 thousand nuts per day can be secured in the neighborhood, which ought to run the plant night and day the year round. Cooking oils, butters, etc., are to be manufactured and, of course, the coir is to be saved, and possibly alcohol will also be produced from the tuba.

THE LIME INDUSTRY.

In the little British colony of Dominica, in the West Indies (an island about the size of Busuanga or a little larger than Marinduque) there is produced no less than 700 thousand pesos worth of lime products every year. It must not be understood, however, that these limes are all consumed in the fresh state

nor exported as fruits; the calico manufacturers really support the lime industry, since it is the citrate of lime, a crude chemical compound made from concentrated lime juice, which is so necessary to "set" the dyes of cotton cloths.

Of course, by no means all of this small island is planted with limes (there being really more hectares under cacao than under limes), yet the total product for the island is estimated at something like 360 thousand barrels (fresh fruits) per annum.

There is no good reason why many districts of the Philippines which are producing practically nothing at present could not be made to turn out as much or more of lime products than does Dominica. A crude-process lime-juice factory is not a very pleasant place to look upon nor to smell, but with modern methods and ordinary cleanliness there is not only big profits but a lot of interesting work to be had from such an institution.

MEXICAN COCONUTS.

Because of the growing world-wide interest in coconuts, or rather copra, even the Pacific coast of Mexico is now coming to see that there is no time to be lost in starting plantations for this industry. Not only in the coast-plain belt (rather narrow on the "back side" of that Republic), but also back in the interior in the "dry country" where droughts are severe, copra is produced in large quantities and is so cheap that it can be carried over rough trails on burros (about 140 kilos per animal being the load) and sold at less than ₱0.14 per kilo. It is even estimated that one average bearing tree will yield ₱5 worth of copra with little cultivation, and about three times that amount when properly handled.

ANIMAL HUSBANDRY IN MEXICO.

Notwithstanding the serious political disturbances of the Mexican Republic during the past two years, the increasing production of horses and mules is much in evidence. It is stated that good "home-grown" mules may now be raised in Mexico at from ₱5 to ₱8 each; these mules readily bring on the market from ₱40 to ₱120, a profit larger than can be obtained in almost any other business in the world. Horses are, of course, more expensive but are raised in large numbers and can be bought for ₱100 and upward.

It is worthy of note that the interest in hinny raising which was apparent some three to five years ago has almost entirely disappeared; this is difficult to understand since it would

obviously be much easier and better for the average stock raiser to keep a good stallion at a central breeding stable in districts where ass mares are cheap and plentiful than to try to keep a large expensive stud of American mares for breeding to a probably second or third class "jack."

NOTES BY C. R. JONES, Entomologist.

BAGWORMS.

A very spectacular sight occurred in Manila during February, which caused no little comment. The "caballero" trees (*Delonix regia*) in various parts of the city had been rather severely attacked by several species of bagworms. It is the habit of the larvæ of the bagworm to form a bag or protective case of leaves or small sticks held together by silken threads, and while still in the trees are unnoticed by the general public. After completely defoliating the trees and upon reaching maturity, and prior to leaving the trees in search of new food or a suitable place to pupate, they suspended themselves from the branches by a tiny, almost invisible silk thread and for several days could be seen floating in the breeze. Some of the defoliated trees along Malecon Drive contained hundreds of these suspended insects at a time, each in its protective case of leaves. Frequent inquiries were made of this Bureau as to why the leaves of these trees were suspended in the air.

ANTS INJURIOUS TO OKRA.

A species of red ants (*Solenopsis geminata*) has been noted to be very injurious to okra. They attack the young fruit buds just before and after blooming, completely destroying the calyx and corolla, and in some cases have done considerable damage by eating into the seed pods. Pods attacked by these ants are generally stunted and very irregular in shape. As these ants are very numerous on the okra plants they have not only become injurious to the plant but their sting is very annoying to the person gathering this vegetable.

The social habit of these ants facilitates their control, to effectuate which it is only necessary to locate the nest, which is always in the immediate vicinity of the attacks, and to apply a small quantity of petroleum, which quickly drives them away.

TOBACCO INSECTS.

In a recent communication the municipal president of San Jacinto, Pangasinan, reported the appearance of insects attacking

the tobacco within that municipality. Some specimens were submitted to this office together with infested stems. The insects contained in the tobacco were of the order Lepidoptera, but as they were in the larval and pupal stages their identification was impossible. However, in all probability this insect is closely allied to the tobacco splitworm (*Phthorimaea operculella* Zell.), but the character of the injury is slightly different from that caused by the latter.

The above-named species attacks the stem and parenchyma of the leaf and is at times found crawling over and feeding upon the outer tissue of the leaves. From the general appearance of the specimens submitted it would seem that this insect spends it entire life cycle, with the exception of the adult stage, within the stem of the plant. The splitworm may be controlled, to a certain extent, by the use of insecticidal sprays; the insect reported from San Jacinto, however, seems to spend the entire life cycle within the plant tissue. A rotation of crops would be necessary for the control of the latter insect. A package of insects, also submitted by this president and reported as being injurious to tobacco, contained specimens of a tree cricket (family Gryllidæ), a long-horned grasshopper (family Locustidæ), and larvæ of *Prodenia litura* Fabr. The two first-mentioned insects, though from general appearance very conspicuous, do very little damage to growing tobacco, and they would have to appear in large numbers before they would necessitate any radical means of control. The larvæ of the last-named species feed ravenously on all solanaceous plants and is at times a serious pest to growing tobacco; when appearing in sufficient numbers they may be easily controlled by a light application of paris green or arsenate of lead.

Another very effective means of controlling this pest is hand-picking shortly after the larvæ have hatched. The eggs of this insect are laid in clusters of from 300 to 500 each. The egg masses are covered with buff-colored hairs which are derived from the anal tufts of the moth. Upon hatching, the larvæ remain clustered from three to five days, feeding upon the epidermis of the leaf and skeletonizing it; thus infested leaves are very readily located. By simply removing and destroying the egg masses or newly hatched larvæ, this pest may be readily controlled.

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The losses caused by insects to various crops, garden truck, and shade trees is far in excess of that supposed by the general

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MECHANICAL INSECT CONTROL.

The losses caused by insects to various crops, garden truck, and shade trees is far in excess of that supposed by the general

observer. This loss is steadily on the increase instead of on the decrease, due to the fact that agricultural areas are becoming larger, thus destroying natural food plants of insects and introducing a new environment. Insects that were formerly unknown as a pest may become noxious on closely allied cultivated plants due to the change in environment and the destruction of the normal host plant; thus we see that the injuries caused by insects and the loss in money value are gradually increasing.

There are several factors which come under the head of natural agencies regarding the control of insects; these may be classed as climatic conditions, and predatory and parasitic enemies. In the control of an insect pest, we should, in addition to these combined natural agencies, apply our artificial means in an energetic, systematical, and coöperative campaign so far as possible. The combined efforts on the part of the planters in a given locality are absolutely necessary, as the efforts of a single person combating or entirely eradicating an insect pest in a single field are of no avail when possibly his next neighbor's field is an ideal breeding place sufficient to supply the entire community.

In order to ascertain when and by what means active measures should be taken in regard to any pest, it is first necessary to study the habits and life history of the insects in question and it is here that the planters can aid greatly by reporting injurious insects and submitting to this Bureau specimens of the plants attacked, together with live and alcoholic insect material.

Numerous requests are made on this Bureau for remedies for various insects, but in most cases they simply state that "an insect is injuring the crops" and ask for the best method of treatment. To requests of this kind it is imposible to give any definite answer without knowing the kind of insect or its method of attack.

Sometimes we receive notice that insects are destroying coconuts, palay, shade trees, or other plants, and we are requested to make an investigation. It is not infrequent that we find, upon investigation, merely the results of the insects, or that the latter are in the last stage of development and that the damage by the prevailing generation is already done. In such cases treatment is of no avail. The danger is over and the plants are safe until the appearance of the succeeding generation. If these insects had been reported in due time, their ravages could have been checked, or a study of the life history and habits could have been made and a remedy given for future outbreaks.

In order for us to give remedies and answer questions intel-

ligently, persons requesting information relative to destructive insects should observe the following points:

1. Insect ravages should be reported at first appearances and not when damage is done.

2. Always submit specimens of the insects in question and of the infested plants.

3. Give the general character of the injury and extent of damage.

4. State the part of the plant attacked.

5. In submitting specimens put them in alcohol or "vino" and give all possible information concerning the insect and its habits.

NATURAL INSECT CONTROL.

Many factors, such as birds, climatic conditions, predatory and parasitic insects, may be placed under the heading of natural insect control. Of these, parasites may be put at the head of the list, as they attack various insects in the egg, larval, pupal, and adult stages. Hymenopterous parasites are probably in excess of all other orders of insects.

A noteworthy incident of natural insect control occurred recently when the eggs of a Pierid were parasitized by a small Hymenopter to such an extent that the ravages of the last generation of this insect were rendered negligible.

The eggs of this Pieridæ are deposited singly on the under side of the leaves of *Cassia siamea* Lam. Upon hatching, the larvæ have heretofore, during the course of their development, completely defoliated the trees which they had attacked.

During November of last year eggs were noticed to have been deposited liberally on the leaves of these trees; some were taken to be bred in the laboratory, and preparations were made to spray the trees when the eggs should have hatched. The collected eggs hatched, but those on the trees did not. Upon examination the latter were all found to be parasitized.

OCCURRENCE OF THE COCONUT WEEVIL.

A recent report from one of the localities known to be infested by the red weevil (*Rhynchophorus ferrugineus* Fabr.) states that the injury by this insect has become so noticeable that remedial measures have been applied. In the municipality of Ambalang, Oriental Negros, the planters are extracting these weevils from the coconut and burí palms. It is reported that one man has killed as high as 800 of these insects in a single day. During the period from the middle of January to February 4, over 52

thousand of these insects were destroyed by the various coconut growers in the above-named section, the greater number of these being taken from burí palms.

At present there are four localities, Oriental Negros, Zamboanga, Laguna, and Tayabas, where this insect causes considerable damage, but to date only the above report has been received as to their appearance this season.

PLANTS RESISTANT TO INSECT ATTACK.

Plants often resist insect attack by "abnormal" growth and by exuding a sticky sap or other similar substance. A noteworthy instance of a plant resisting the attack of insects occurs in the seed heads of lettuce (*Lactuca sativa* L.). Upon the slightest touch to lettuce seed heads this plant exudes a milky, sticky substance, and when the insects alight upon it they are immediately fastened to the plant, and in their efforts to get away the plant is disturbed still more causing it to throw out still greater quantities of this protective latex, till at last the insects are held rigid and thus soon die. Lately, at Singalong, it was noted that the lettuce seed buds were covered with dead insects, including the following:

Pentatomidæ: *Nazara viridula* Fabr.; *Eurydema pulchrum* Westw.

Pyrrhocoridæ: *Dysdercus singulatus* L.; *Dysdercus poedilus* H. S.

Capsidæ: One species; Hymenopterous parasites, four species; Diptera and Microdiptera, five species.

Chrysomelidæ: *Aulacophora coffeæ* Hornst; one other species.

Lygaeidæ: One species.

Reduviidæ: One species.

NOTES BY P. J. WESTER, Horticulturist.

CINCHONA.

Ever since the efficacy of quinine against malarial fevers was discovered and the drug introduced into Europe in 1639, there has been great interest in the plants from which this valuable drug is obtained, especially among those European nations possessing colonies in the Tropics, and subsequent to the introduction of the cinchona plant into India in 1861 its cultivation has spread over considerable areas in that country; it is also extensively cultivated in Java.

The cinchona is indigenous to tropical South America, occurring between the tenth and the twentieth degree of latitude and is found at its best at an altitude of from 450 to 1,800 meters. The number of species that yield quinine is considerable, but there are only a few that are sufficiently rich in the drug to warrant their exploitation for this purpose. *Cinchona calisaya* Weddell, of which there are several varieties, is richest of all in quinine (containing 5 to 6 per cent) and therefore this species is the one most extensively cultivated. One of its best-known forms is *C. ledgericena*. *C. calisaya* is a tree very variable in size that thrives best at an elevation of 450 to 900 meters. *C. succirubra* Pavon attains a height of 15 meters or more, and succeeds up to an altitude of 1,800 meters, preferring a cool climate. *C. officinalis* Hooker is a straggling tree some 6 meters in height; like the preceeding species it does best in the higher elevations. The cinchonas succeed best on hillslopes where the soil is rich and well drained and where the rainfall is fairly abundant, though in this latter respect they are not so exacting as was formerly thought. The plants are easily propagated from seeds or cuttings.

It is quite probable that the cinchonas will thrive in many parts of the Philippines having the right qualifications and the Bureau of Agriculture has recently introduced *C. calisaya* with this object in view.

A NEW OIL INDUSTRY.

The rest of the world has much to learn from Europe in the utilization of waste products. One of the latest bits of news in this line is the manufacture of grape-seed oil for culinary and industrial purposes in France, Italy, and Württemberg. We quote the following from the Daily Consular and Trade Reports for January, 1913:

> That obtained cold, from the first pressing, is edible; the oil obtained by pressing and heating, and that extracted by means of solvents, have a dark color and a bitter taste, and after being purified by concentrated sulfuric acid and cleared with bone black, are used for lighting purposes and in the manufacture of soap and, on account of the small cost, they would be a good substitute for the expensive oils used in the textile industry. Aside from the uses mentioned, and because some of its chemical properties are similar to those of castor oil, grape-seed oil has suggested itself as a substitute for castor oil in the preparations of compounds used in the manufacture of red colors.

The quantity of oil that can be obtained from the seeds varies from 6 to 20 per cent according to the variety of grape and

the degree of ripeness. On an average, 1 kilo of oil is rendered for each hectoliter of wine produced.

THE OLIVE-OIL CROP IN THE MEDITERRANEAN COUNTRIES.

We may look for an advance in the price of olive oil. Owing to the spread of the olive fly and its recent severe ravages in all olive-producing countries bordering the Mediterranean, the current year's crop will be greatly reduced. The yield in Italy is estimated to be only two-thirds, and in Spain only one-fourth of a normal crop. In France the outlook is for a fair crop, but inferior in quality; in Corsica the olive is this year a total failure and in Algeria the crop is insufficient for local consumption. In Tunis, Asiatic Turkey, and Greece the crop will be poor and mediocre in quality.

The olive fly is a relative of the Mediterranean fruit fly which has been so destructive to the orchard fruits in that region, from which it takes its name; it has also been destructive in South Africa and Australia; more recently, it has become notorious through its invasion of Hawaii. It is also related to the mango fruit fly discussed by the writer in a previous issue of the REVIEW.

MATÉ OR PARAGUAY TEA.

In South America the maté occupies the position filled by tea in England and in the United States and the preparation of maté is in certain parts of the continent an industry of paramount importance. However, the leaves have so far been gathered chiefly from the forest and there are no regular tea plantations such as one finds in Japan, Java, and other parts of the East. Owing to the enormous extent of the maté forests no thought has been given in the past to their possible exhaustion and the harvest of the leaves has proceeded with little or no regard for the maintenance of this source of wealth. Paraguay now seems to have awakened to the danger of loosing her revenues from the maté industry and a law has been promulgated regulating the exploitation of the maté forests, limiting the gathering of a crop of leaves in any one place to once in every four years.

There is already a limited demand for maté in Latin Europe and small experimental shipments of the product have been made to the United States, though as yet this beverage is practically unknown to the Anglo-Saxon. There is but little doubt, however, as to its future ranking in popularity with ordinary tea and coffee.

Maté was introduced into the Philippines some years ago and a plant in flourishing condition may be seen at the Singalong experiment station. The species is of very vigorous growth, and, should it ever become expedient to grow it in the Islands, the present indications are that it would succeed exceedingly well.

FOX FARMING.

In most countries the fox is considered a predatory pest and its extermination is encouraged by bounties. Now comes news from Prince Edward Island of its domestication there. The domestication of the fox is not so very recent, for it dates back to 1888, or nearly a quarter of a century ago. It is the gradual extermination of the black and silver fox, with the attendant increase in the price of their pelts, that is responsible for the birth of this new industry. As much as upward of ₱7,800 has been paid for a single black-fox skin.

According to the Daily Consular and Trade Reports there are now some 50 ranches of considerable size on the island, and including those who keep from one to five pairs of foxes, the aggregate number of places where foxes are kept is estimated at 300 with nearly 2,000 animals. The total value of the fox ranches is computed at 8 million pesos. Profitable as is the pursuit in the production of skins, the revenue from the sale of breeding animals is still greater—₱20,000 to ₱30,000 have been paid for a single pair.

Fox farming has evidently passed the experimental stage in this part of Canada, if we may judge from the fact that legislation has been enacted for its protection in at least three provinces of the Dominion.

NOTES BY M. M. SALEEBY, Chief, Fiber Division.

CARLUDOVICA PALMATA IN THE PHILIPPINES.

Carludovica palmata is the plant which produces the material from which the famous panama hats are made. It belongs to the *Cyclanthaceæ* family and not to the *Palmæ*. The plant resembles the young burí (*Corypha elata*) and the young anahao (*Livingstonia*) palms before their stems have appeared. The specific part of the name of this plant refers to its general resemblance to a palm tree.

C. palmata is a stemless plant having leaves plaited like a fan and borne on a three-cornered stalk which ranges from 2 to $4\frac{1}{2}$ meters in length. The leaves proper are about $1\frac{1}{3}$ meters in

diameter, deeply divided into four or five divisions, each of which is again cut. The plant flourishes in shady places all over Panama and also along the coasts of Ecuador and Colombia in South America.

The method used in Panama in preparing the leaves of *C. palmata* for weaving hats is very similar to that used here in the Philippines in preparing sabutan leaves for weaving sabutan hats.[1] This method is briefly as follows: The leaves are cut before they are expanded, and the woody ribs, or stiff parallel veins, are removed. The leaf is then slit into narrow strips which remain attached at the stalk end. These strips are then immersed in boiling water for a short time and afterwards dried and bleached in the sun. When completely dry the strips roll up into a straw-like form, at which stage they are bleached prior to hat weaving.

A few years ago some *C. palmata* seed was received by this Bureau and planted at the Lamao experiment station. This seed did not germinate satisfactorily, due probably to deterioration, and only two plants were obtained from it. These plants, however, made a very fair and rapid progress. Late last year as many as 40 shoots were obtained from these two plants, which were planted in a separate plat from which they will later be transplanted to the La Carlota experiment station, Occidental Negros, where the rest of the fiber experiments are being caried on. A request has also been made by the fiber division to secure a fresh lot of seed from Panama, and as soon as this is received it will be planted in a nursery at La Carlota for future distribution of seedlings and shoots. The seed is considered too delicate to be handled by persons who have no expert knowledge in germinating very small and delicate seed similar to the kind in question.

C. palmata is now cultivated in Java and hats are being woven from the prepared leaves by Javanese women and children, and the Java panama hat compares favorably with the common grades turned out in Panama. Conditions in the Philippines appear to be also favorable to the growth of the plant, and with the unexcelled skill of the Filipinos in the art of hat making, it is believed that the panama-hat industry can be successfully established in those provinces in which hat weaving is the chief household industry.

[1] See Current Notes in the April, 1913, issue of this REVIEW.

ANABO (*Abroma augusta*).[1]

This plant is found growing wild throughout the Archipelago.[2] It is cultivated as an annual crop only in the town of Bacolor, Pampanga Province, where it is grown from seed planted during the latter part of September. The soils best adapted for the growth of this plant are the low, wet soils, such as are required for rice. The plant attains a height of 2 to 5 or more meters when full grown. It usually takes seven or eight months from planting before the stalks are mature. This period, however, may be considerably shortened by proper cultivation.

The fiber is a bast derived from the bark of the twigs. The bark, after being stripped off, is soaked in water for four or five days, when the fiber can be readily separated. The fiber, when properly cleaned, is soft, white, and strong. Up to the present time it has been used merely for local purposes. Ropes, hammocks, and nets for hunting deer are the principal articles manufactured from it. It is believed that the fiber can be used for many purposes for which jute and other similar fibers are employed. Several samples of this fiber were forwarded to cordage manufacturers, both in the United States and England, for their opinion regarding its prospects as a commercial fiber. The following is an extract from the report of Messrs. Smith and Schippers, of New York:

> We believe this fiber will be of value commercially, but to get a decent market price the fiber would have to be better cleaned. There seems to be quite a little gum left in the sample, and this causes the fiber to be matted, which makes it difficult to spin. A little more attention paid to the cleaning would result in a pretty good fiber, in our opinion.
>
> The length and strength are satisfactory for a fiber of this kind, and the color is good. We should say it resembled more than any other fiber Tientsin, China, jute, and could be used for the same purposes, i. e., as a mixer with Indian jute, and for some grades of tarred cordage. As a mixer, the color must be all right, but the chief point in its favor is its length, as it helps to carry the shorter fibers which are used along with Tientsin in the making of cordage.

The fiber division of this Bureau, basing its efforts upon the above-mentioned report and others from other sources, has already taken up the question of the cultivation of anabo and the preparation of its fiber, with the view of determining whether

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[1] Sometimes known as "devil's cotton."

[2] Other species belonging to other genera are found, which are also called "Anabo."

or not this can be carried on on a commercial basis. It is believed that the cultivation of anabo as an alternate crop with rice will give good results, providing a practicable method can be devised by which the fiber can be properly cleaned and providing a sufficiently high price can be obtained for it.

ANNOUNCEMENT.

GHENT INTERNATIONAL EXHIBITION, 1913.

TENTH INTERNATIONAL CONGRESS OF AGRICULTURE.

The International Congress of Agriculture which will be held at Ghent, Belgium, June 8–13, 1913, is the tenth of the series of periodical congresses which were inaugurated at Paris in 1889.

Agricultural meetings had hitherto been organized in various countries at indefinite dates. They had no connection with each other, and their influence was merely temporary. At the congress which was held in Paris, on the occasion of the international exhibition of 1889, a permanent committee was constituted, and under the designation of the International Commission of Agriculture, was charged with the duty of convening and organizing congresses at subsequent dates. This commission includes among its members leading representatives of the principal agricultural associations, etc., in various countries; and with M. Jules Meline as its chairman, it has unceasingly and actively continued to fulfil its mission.

The extensive series of reports which have been issued by these congresses indicate the importance of the work which they have accomplished, and their effect in diffusing knowledge of the agricultural progress which has been attained in various countries. The meetings, moreover, are of great advantage as a means whereby specialists and agriculturists of all countries get to know and esteem each other, fostering good fellowship which tends to mutual advantage.

Each congress decides where the next one shall be held. The ninth congress at Madrid accordingly accepted the invitation of the Belgian members of the International Commission of Agriculture that the tenth congress should meet at Ghent on the occasion of the international exhibition of 1913.

This congress will be international in the widest sense of the term, inasmuch as the subjects on the program may be discussed from a universal point of view, notably as regards tropical agriculture.

The committee which has accordingly been formed in Belgium has prepared the program of the congress in consultation with the international commission. It therefore appeals to the agriculturists of all countries, including colonies, to assist in making this meeting worthy of its predecessors.



(*a*) Agricultural demonstration car now under construction.



(*b*) Interior of demonstration car.

DEMONSTRATION AND EXTENSION NUMBER

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CONTENTS.

	Page.
Editorial	263
Coöperative Agricultural Demonstrations	265
Act No. 2226. An Act to establish stations for practical instruction in matters concerning agriculture and a system of agricultural demonstration and development	269
Act No. 2229. An Act authorizing certain measures for improving the planting, curing, and preparation of tobacco	271
A Demonstration Project	272
Demonstration Work in the Provinces Around Manila	279
The Iloilo-Capiz Demonstration Project	281
Coöperative Demonstration Work in the Island of Cebu	284
Demonstration Work in the Province of Batangas	289
Demonstration Work in the Mountain Province and Nueva Vizcaya	293
Extension Work in Coöperation with the Manila Railroad Company	297
The Nueva Vizcaya Agricultural Fair	300
Farmers' Coöperative Demonstration Work in the United States	302
Temperature and Rainfall—March	307

118654

ILLUSTRATIONS.

PLATE I. (*a*) Agricultural demonstration car now under construction; (*b*) Interior of demonstration car ..... Frontispiece.

Facing page—

II. Native white flint corn, showing results of seed selection 276
III. Tobacco field, showing "bagging" method of seed selection 276
IV. Iloilo demonstrators and demonstration products 276
V. The Iloilo demonstration station 276
VI. Cutting cogon sod with a disk harrow at the Iloilo demonstration station 276
VII. Implements used in Iloilo demonstration work 276
VIII. Maize plot at the Iloilo demonstration station 292
IX. (*a*) A Cebu demonstration plot; (*b*) Maize grown on a Cebu demonstration plot 292
X. (*a*) Demonstration exhibit at the 1913 Iloilo Fair; (*b*) Products of the demonstration station shown at the 1913 Iloilo Fair 292
XI. "Bedr, jr.," a mestizo stallion at the Batangas station; (*b*) Native mares shown at the 1913 Batangas Live-stock Show 292
XII. Live stock shown at the 1913 Nueva Vizcaya Agricultural Fair 292

EDITORIAL.

COÖPERATIVE AGRICULTURAL DEMONSTRATIONS.

By the ASSISTANT TO THE DIRECTOR.

There is urgent demand in this day and generation for plain, practical, and positive results. It matters not if it be a man, a machine, or a method, the degree of efficiency is measured by the results obtained.

In no field of effort is this more true than in that of agriculture. Farming is a very practical business proposition, and the business that does not show results does not last very long. Farms are not operated, in the vast majority of cases, as an amusement, but to furnish a living for the farmers.

What is true of farming in general applies, at least in some degree, to any measures taken for the improvement of agriculture. The two cases are not entirely parallel for the reason that the Government with its bureaus, experiment stations, colleges, and schools very properly carries on lines of investigation which must often bring negative rather than positive results. That which is demanded of the Government in its agricultural work, and it is an entirely reasonable demand, is that the results obtained by investigation be so transmitted to the farmers that they may be used in a practical way.

The most vital industrial problem now before the people and the Government of these Islands is to devise and put into active operation a practical and comprehensive scheme that will insure the healthy development of our agriculture. Although endowed with enormous natural wealth, chiefly agricultural, the country has suffered from a long period of industrial depression. The work of improvement has been well started and it is imperative that it be continued and developed in an effective way.

The work of promoting agricultural improvement by means of "coöperative agricultural demonstrations" is not a new idea, neither is it an experiment. This system was first utilized by the United States Department of Agriculture in 1904 with one inspector working on one farm. Eight years later 600 inspectors were carrying on coöperative demonstrations with a hundred

thousand farmers. This development was due to the simple fact that this work gives results.

In the Philippine Islands coöperative demonstration work has only recently been established. It is of interest to note, however, that in one province more corn was hauled by the railway in the three months following the first period of demonstration work than had been hauled during the previous three years. In another province more agricultural implements were sold in six months than had been sold during the previous four years. These are surely practical and positive results.

In this number of the REVIEW an outline is given of the principal features of the coöperative demonstration work, its present status in the Philippine Islands, and the plans that have been made for its development.

COöPERATIVE AGRICULTURAL DEMONSTRATIONS.

By H. T. Edwards, *Assistant to the Director.*

There are in the Philippine Islands approximately 815,000 farms. Of this number about 725,000, or nearly 90 per cent, have an area of less than 5 hectares each. The men who work these small farms constitute the great bulk of the farming population of the Islands, and any scheme for the general improvement of agricultural conditions throughout the Archipelago must be based on measures adapted to reach and influence the small farmer. It is frequently stated that the Filipino farmer has no desire to adopt improved methods, and that he will not change his present practices. Experience has shown, however, that there is a widespread demand on the part of the farmers throughout this country for information, and wherever it has been possible to clearly demonstrate that the use of modern methods will produce satisfactory results these methods are eagerly and quickly adopted.

A mistake that has been altogether too common has been the attempt to introduce practices for which the Filipino farmer is not yet prepared. The average small farmer in the Philippines has practically no working capital. He usually has but one or two work animals and frequently none at all. His farm equipment is of the most meager description, and he has not the means to make any immediate extensive improvements in this equipment. He is accustomed to growing one or two crops, and to the use of methods that have been followed in his community for generations. All of these conditions should receive full consideration before any work is undertaken to improve agricultural conditions in the Philippines. There are, of course, many exceptions to the above-stated conditions. Large and well-developed plantations on which modern improvements can be immediately introduced are to be found in every province. The essential fact remains, however, that 90 per cent of the farming population of the Philippines are the small farmers, and our most vital agricultural problem is to devise and put into active operation a practicable scheme that will enable these small farmers to improve the conditions on their farms. It is worth while to note in this connection that although improved practices suitable for the well-equipped plantation are often entirely beyond the reach of the small farmer, the improvements that can be

adopted on the small farm are equally valuable on the large plantation.

It is a well-established practice in the working out of any scheme which has for its object the improvement of agriculture to first ascertain certain facts by means of investigation and then to transmit this information to the farmers by means of correspondence, printed matter, and lectures. This method is not without its advantages and will produce, even in the Philippine Islands, a certain amount of results. In the vast majority of cases, however, it is entirely fruitless when it comes to the matter of improving the condition of the small farmer. The vast majority of Filipino farmers do not read either English or Spanish. Publications in the local dialects will be more widely read and lectures are even more effective than any printed matter, but in the end the fact remains that the Filipino farmer needs to be shown rather than told how to use improved methods.

It is a very simple matter to describe in great detail the advantages of using better implements and improved methods of soil preparation, the value of seed selection and seed testing, and the importance of thorough cultivation and diversification of crops. If results are desired, however, it is a thousand times better to go out on a farm in the provinces with a small, inexpensive modern plow; to show the farmers of a community how such a plow can be used, what it will do, what it costs, and where it can be purchased; to show how good seed can be selected and tested; to have this seed properly planted in ground that has been well prepared; and to see that the crop is cultivated, protected from insect pests, and properly harvested. In the one case a certain amount of casual interest may be aroused on the part of a limited number of people; in the other the entire community is given a definite, striking object lesson that can not fail of being understood. The second method of procedure is that which is known as coöperative agricultural demonstrations.

The Filipino farmer during the past decade has suffered from a series of disasters that in a country less richly endowed by nature would have been overwhelming. His herds have been decimated by rinderpest; his crops have been destroyed by locusts and drought; and certain sections have been devastated by typhoons and floods. Even under these unfavorable conditions there has been progress, and the general agricultural situation throughout the Archipelago is more encouraging at the present time than it has been at any previous time during the past ten years.

As a basis for future development, most important work has already been done. Rinderpest, which in earlier years made the question of agricultural progress in any province a matter of uncertainty, is now largely under control. Locust infestations of the most serious nature have been entirely eradicated in certain provinces and have been controlled in other sections during the past year, showing that the destruction of this pest is only a matter of energetic and coöperative effort. Irrigation works are being developed in different parts of the country which will eliminate in the sections where these works are constructed the danger of loss from drought. Transportation facilities have been enormously improved by the construction of better roads in all provinces and by the building of railroads through the more densely populated sections of Luzon, Panay, and Cebu. Investigational work along agricultural lines has resulted in the acquirement of valuable information that can now be utilized to advantage on Philippine farms. In addition, and what is perhaps more important than any of the factors previously mentioned, is the fact that the Philippine farmer is beginning to realize the advantages of using improved methods of agricultural practice, and is seeking the means of bringing these methods home to his own farm. This is shown by the rapidly increasing demand that is being made by the farmers for information and assistance from the Bureau of Agriculture.

The most important feature of our agricultural problem at the present time is to develop simple and practicable methods that will influence the farmers of these Islands to adopt improved practices. The farmers are ready for such improvement, and the information which they desire is, in a large measure, available. This work is already under way and has been carried on to a limited extent in several provinces during the past year. During the coming fiscal year it will be largely increased under the provisions made by the Philippine Legislature for the establishment of a system of coöperative agricultural demonstrations.

This system of coöperative agricultural demonstrations has been widely discussed and is now quite generally understood. Briefly stated it is a method by which information is taken to the farmers and directly taught to them on their own farms. Instead of attempting to disseminate information solely by means of correspondence or publications, trained and experienced men are sent out to the farmers of the different districts. In each locality the progressive farmers who desire to take up the work are enlisted as coöperators. On the farm of each coöperator a

plot of land is selected and this plot is prepared, planted, cultivated, and harvested by the farmer working under the direction and with the assistance of the inspector. The entire crop goes to the farmer who receives not only the benefit of the instruction, but also increased returns from his land.

The coöperative demonstration work is not an experiment, and under normal conditions success is practically assured. The Bureau of Agriculture corn demonstration plots in the Province of Cebu during the past year yielded an average of 59.1 cavans [1] per hectare. The average yield on land farmed by methods in common practice in the Province of Cebu was 32.5 cavans per hectare. The yields on demonstration plots cultivated by modern methods were, in this instance, 81 per cent higher than the yields on lands of the same character cultivated by the old methods. Equally positive and convincing results have been obtained in other localities where demonstration work has been carried on.

It was believed, when this work was first started, that difficulty might be experienced in obtaining the necessary coöperators. As a matter of fact, the very opposite has been the situation, and it has been impossible to furnish a sufficient number of inspectors to supervise the plots of farmers who have expressed a desire to become coöperators. This is particularly true in localities where the work has been under way a sufficient length of time to demonstrate its value.

Up to the present time coöperative demonstration work has been started by the Bureau of Agriculture in the following-named provinces: Cebu, Iloilo, Capiz, Surigao, Bohol, Albay, Batangas, Laguna, Rizal, Isabela, Nueva Vizcaya, and the Mountain Province. In several of these provinces the work has only recently been organized, in others it is now well-established and already beginning to show definite results.

Agricultural demonstration work, although comparatively new in the Philippine Islands, has been thoroughly worked out in other countries. Wherever it has been adopted it has been a success, and this method of instruction is now generally recognized as the most practical and effective system known for promoting agricultural improvement. Conditions in the Philippines are such that the establishment of coöperative agricultural demonstrations throughout the Islands appears to be entirely feasible and in every way desirable. There is abundant indication that such a movement will receive the hearty support of Philippine farmers.

[1] One cavan equals 75 liters.

A. B. No. 396.

THIRD PHILIPPINE LEGISLATURE,

Special Session of 1913.

[No. 2226.]

An Act to establish stations for practical instruction in matters concerning agriculture and a system of agricultural demonstration and development.

By authority of the United States, be it enacted by the Philippine Legislature, that:

SECTION 1. The Director of Agriculture is hereby authorized to establish, equip, maintain, and operate in such places in the Philippine Islands as may be considered suitable for the purpose, stations for practical agricultural instruction, and to establish, organize, maintain, extend, and develop, and from time to time change and improve, a system of coöperative agricultural instruction, all for the purpose of teaching perfected methods of soil selection, preparation, and fertilization, planting and harvesting vegetables, fruits, cereals, and other crops, production of improved seeds and plants for distribution, improvement of the breed of animals used for agriculture, and to further by other means and encourage and teach agriculture and agricultural work.

SEC. 2. Whenever circumstances are deemed favorable, stations for practical agricultural instruction may be established and conducted, maintained, equipped, and operated coöperatively by the Bureau of Agriculture and any province, municipality or agricultural association of the Philippine Islands; but any station for practical instruction established under the provisions of this Act shall be managed under the supervision and control of the Director of Agriculture.

SEC. 3. The Director of Agriculture is hereby authorized to appoint and employ station superintendents, traveling inspectors, clerks, operators, messengers, and all other employees deemed necessary for carrying on successfully the work to which this Act refers, and to fix their salary; to purchase or lease the necessary land and buildings, to install wells and other irrigation

systems, to acquire by purchase, donation, exchange, or other contract, all animals, plants, fuel, machinery, vehicles, apparatus, equipment, tools, implements, and articles necessary for the proper operation of this Act, and to expend for these purposes the money appropriated by this Act.

SEC. 4. The duties by this Act imposed upon the Director of Agriculture shall be performed under the general direction and with the approval of the Secretary of Public Instruction.

SEC. 5. The sum of one hundred and fifty thousand pesos per annum or so much thereof as may be necessary, is hereby appropriated, out of any funds in the Insular Treasury not otherwise appropriated, to carry out the provisions of this Act.

SEC. 6. This Act shall take effect on July first, nineteen hundred and thirteen.

Enacted, February 7, 1913.

A. B. No. 284.

THIRD PHILIPPINE LEGISLATURE,

Special Session of 1913.

[No. 2229.]

An Act authorizing certain measures for improving the planting, curing, and preparation of tobacco.

By authority of the United States, be it enacted by the Philippine Legislature, that:

SECTION 1. It is hereby directed that the Director of the Bureau of Agriculture station in the tobacco-producing provinces employees of his Bureau, experts in the planting and production of tobacco, to make experimental demonstrations in suitable municipalities or places, relative to the adoption and use of modern methods of planting, cultivating, curing, and preparing tobacco and the selection of the soil, the planting and cultivation of foreign tobaccos, and any measures that may be necessary for instructing the tobacco growers.

SEC. 2. The Director of the Bureau of Agriculture shall, for the purposes of this Act, establish in the province or provinces where he may deem it advisable, an experimental station dedicated especially and exclusively to experiments in tobacco cultivation and production.

SEC. 3. The sum of ten thousand pesos is hereby appropriated, out of any funds in the Insular Treasury not otherwise appropriated, for carrying out the provisions of this Act: *Provided,* That provinces and municipalities desiring to be benefited by such experimental demonstrations shall participate in the expenditures occasioned by such experimental demonstrations, which shall be assessed pro rata by the Governor-General; but in no case shall the share of the province or municipality exceed two-fifths of the actual cost of such experimental demonstrations: *Provided, however,* That the share of the municipality shall in no case be equal to or larger than that of the province: *And provided further,* That the sum appropriated by this Act shall not be applicable to salaries and expenses of the personnel appointed by the Director of Agriculture.

Enacted, February 8, 1913.

A DEMONSTRATION PROJECT.

By H. T. Edwards, *Assistant to the Director.*

Under the present organization of the Bureau of Agriculture the entire work of the Bureau is carried on under a series of so-called projects. Each project covers a certain definite line of work, is under the supervision of some one employee who is directly responsible for the results obtained, and for each project a fixed allotment of funds is made to cover the expenditures of each fiscal year.

Each project of the demonstration and extension division of the Bureau includes the work of a certain district, ordinarily one province or island. Thus we have at the present time the Cebu project, the Panay project, the Mountain Province project, etc. It is proposed ultimately to establish one demonstration project for each province in the Archipelago, with such number of coöperative demonstration stations as may be required by existing conditions.

There are two main lines of work in connection with each demonstration project, viz, the demonstration station and the coöperative plot work throughout the province. The principal object in having the demonstration stations or farms is to provide a centrally located headquarters for the work of that province, and a place where certain lines of work can be carried on to better advantage than would be possible on the farms of coöperators.

The demonstration station serves as a training station for the traveling inspectors. As new men are employed they are sent first to the station for preliminary instruction under an experienced man. Subsequently they return to the station from time to time and thus keep in touch with the work of other inspectors in that province.

A part of the land at each station is used for the growing of seeds and plants for distribution. Under favorable conditions, where seeds can be produced in large quantity, this line of work covers in considerable part the cost of operating the entire station.

Where live-stock breeding is carried on as a part of the demonstration work, as it will be in the majority of cases, the station is the headquarters for this work. At the Batangas station animal breeding has thus far been the most important and successful part of the work.

In certain provinces it will no doubt be found desirable to do a limited amount of experimental work either with new varieties of plants already grown, or with plants entirely new to that section. As the coöperative plots are not intended to be experimental, this work must necessarily be done at a station.

The demonstration station is, however, as its name implies, intended primarily as a place where field demonstrations can be carried out on a somewhat larger scale than on the farms of coöperators, and at a place where they will be observed by a larger number of people than would ordinarily see any of the coöperative plots.

The establishment and supervision of coöperative demonstration plots on the farms is the second part of the work of a demonstration project. This work is handled by traveling inspectors, to each of whom is assigned a certain definite district. It has been ascertained that an important factor in determining the success of the coöperative work is the frequency and regularity of the visits of the inspectors. It is by no means sufficient that the inspector select a suitable plot of ground and that he have this plot properly prepared and planted. From the time of planting until the crop is harvested each plot should be visited as frequently and as regularly as conditions will permit in order that suggestions may be given regarding cultural methods and the control of pests and diseases.

In the demonstration-plot work every effort is made to have the work as simple and practical as possible. The crops grown on the demonstration plots are usually those with which the farmer is familiar and which he has previously cultivated.

The main features of the coöperative demonstration work are as follows:

1. The selection of the crop best suited to the land available for the demonstration.
2. Drainage.
3. The thorough preparation of the land before the seed is planted.
4. The use of seed of the best variety obtainable, and seed that has been carefully selected and tested.
5. The use of proper methods of planting.

6. Intensive tillage during the growing season.

7. The importance of utilizing leguminous plants, barnyard manure, farm refuse, and any other available material suitable for building up and improving the soil.

8. Methods of controlling and eradicating plant pests and diseases.

9. The value of crop rotation.

10. The reasons for diversified farming.

11. The use of better tools and implements.

12. The proper care of live stock.

13. The production on the farm of all food required by both men and animals.

14. Farm management.

It is hardly necessary to state that each demonstration does not offer an opportunity for utilizing fully all of the above-mentioned lines of work. It is equally true that special cases frequently arise where work other than that usually covered by the demonstrations can be carried on to advantage.

In making the preliminary arrangements for a coöperative demonstration an effort is made to secure land that is near a public highway in order that the results of the demonstration may be observed by a large number of people. When the land for the plot has been selected, it becomes necessary to also select the crop best suited for this particular land. In this work the inspector can frequently furnish the farmer valuable suggestions with reference to the management of his entire farm, and the planting of crops best adapted to existing conditions.

Nearly all of the staple crops of the Philippine Islands require well-drained land. The question of drainage is one that has received but little attention on the part of the farmers. In many cases a simple, but at the same time effective, system of drainage that will greatly improve the condition of the soil can be installed with little labor or expense. It is preferable that land be drained by under drainage rather than by open ditches or the surface method. With tiles or bamboo laid below the tillage level the water will readily sink into the ground leaving the soil in good condition without carrying off any considerable amount of plant food. Water that would run off in an open ditch will be held in the subsoil where underground drainage is used and will be utilized by the growing plants in times of drought. The use of bamboo for under drainage will be given special attention in the demonstration work.

In the work of preparing the land for planting an effort is made to encourage the use of some one of the improved small

plows that are now on the market. In cases where such a plow is not available the ordinary native plow is used. Thorough preparation of the seedbed is of more importance than is generally realized, and this is required as the first step in the demonstration work. In order to obtain the best results with a crop it is essential that the soil be well pulverized and in good mechanical condition before the seed is planted. The methods of preparation vary more or less with different crops. Some plants require a deeper soil than others, and the seeds of certain plants can not be satisfactorily germinated except in a soil that has been very thoroughly pulverized, while other seeds contain a large amount of plant food which is used by the seedling until such time as the root system is fairly well developed. These various matters require consideration and attention in connection with the soil preparation.

The use of good seed is perhaps the most important line of work carried on in connection with the coöperative demonstrations. This work does not require any equipment on the part of the farmer and it can be used with all crops and in all localities. The fact that the use of poor seed is the rule rather than the exception in this country is one of the principal reasons why unsatisfactory results are obtained. It is not only necessary that good seed be used, but it is equally important that a variety of seed be planted which is adapted to local conditions. With the establishment of the demonstration stations it will be possible to produce in each province a supply of selected seed for local use, and by seed selection on the demonstration plots the supply will be still further augmented. Where it is necessary the seed used for the first planting of the demonstration plots is furnished by the Bureau of Agriculture, with the understanding that from that crop selected seed will be saved for the following planting. If the custom of using good seed can be generally established throughout the Islands this one improvement alone will result in a vast amount of benefit to the farmers.

Improved methods of planting is an improvement that requires no increase in labor or expenditure. It costs no more to plant a hectare of maize properly than it does to plant it according to methods now in general use. As a matter of fact the cost is generally less as too close planting and consequent waste of seed is the usual practice in this country. The reason for giving enough space between the plants in the row, and between the rows, lies in the fact that every plant requires sunlight and air, and room for development both above and below the surface of the ground. In the demonstration work the aim is to plant such

an amount of seed as will give the maximum amount of product on a given area. One has only to observe the great tracts of coconut land where the trees are planted so close together that the yield is reduced to a minimum, the abacá plantations where similar conditions often prevail, and the fields of small, stunted maize, to appreciate the need for improved planting methods in the Philippines.

Intensive cultivation is an improvement in Philippine agriculture that will have to be introduced gradually. The demonstration inspectors endeavor not only to explain, but also to show by the results obtained the value of frequent cultivation of the crop during the growing season. The main objects of tillage of the soil during the growing season are three: First, to increase the supply of plant food by rendering the soil constituents available; second, to destroy weeds; and third, to conserve the supply of moisture for the growing plant. Thorough tillage also serves to keep the soil in good mechanical condition. It is a noticeable feature of this work that after one crop has been grown on a demonstration plot, and the coöperator fully understands that improved results can be obtained by more thorough tillage, the securing of proper cultivation of subsequent plantings is not a difficult matter.

The extent to which fertilizers can be profitably used in the Philippine Islands has not been fully determined. On the larger plantations where capital is available and where large areas are planted to a cash crop the use of commercial fertilizers is highly desirable. The majority of the small farmers are not in a position to purchase commercial fertilizers and must depend on home products. The more general planting of leguminous crops for green manuring, and the use of barnyard manure and farm refuse are measures that can be generally recommended. There is, at the present time, an enormous waste of good fertilizing material in these Islands, a large part of which should be saved and used on the land.

Throughout the growing season many of our Philippine crops are subject to the attack of insect pests and plant diseases. The average Filipino farmer has little or no equipment with which to combat these pests and diseases and as a consequence suffers serious losses that might, in many cases at least, be averted. During the past year several of the demonstration inspectors have rendered excellent service in the locust campaign. The control and eradication of a locust infestation depends in a large measure on the promptness with which the first outbreaks



Native white flint corn, showing results of seed selection.



Tobacco field, showing "bagging" method of seed selection.



Iloilo demonstrators and demonstration products.



The Iloilo demonstration station.



Cutting cogon sod with a disk harrow at the Iloilo demonstration station.



Implements used in Iloilo demonstration work.

are handled and the efficiency of the work in its early stages. With a trained man on the spot, who understands local conditions and who has the confidence of the people, the work of controlling the locust pest is greatly facilitated. The conditions with respect to locusts apply equally well to other insect pests. The demonstration inspectors not only assist in the control of any particular outbreak, but also furnish information to the farmers which will enable them to continue this work in the future without outside assistance.

The "one-crop" system of farming is very generally followed throughout the Philippine Islands. In certain provinces rice is extensively cultivated and all other crops are neglected. In other provinces the one crop of importance may be abacá, sugar cane, or coconuts. When this one crop fails the results are bound to be disastrous. A severe drought in the rice provinces often results in a serious shortage in the food supply and occasionally is attended by considerable suffering and a condition of destitution. Under normal conditions in the abacá, coconut, and tobacco sections a very large part of the proceeds received from the sale of these crops is required for the purchase of food that should be grown on the farms. It is probable that the majority of the small farmers in the Philippines are not in a position to introduce any comprehensive system of rotation, or possibly to grow but one staple cash crop. There is no good reason, however, why these farmers should not grow secondary crops such as maize, garden vegetables, and friuts. During the last severe drought the rice districts in which maize was also cultivated suffered much less severely than those places where rice was the one crop. In the coöperative demonstration work special attention is given to the encouragement of gardening and the planting of fruit trees with a view of improving and increasing the food supply of the people.

It is impossible to obtain entirely satisfactory results when the land is prepared and tilled with the implements now in general use in these Islands. The fact must not be overlooked, however, that a very large number of Philippine farmers have not the necessary means with which to purchase improved implements. The aim of the demonstration work is to show the best possible work that can be done with the implements that are available, and also to show that better results can be obtained with better implements. Frequently all that is required is a demonstration of a good plow, harrow, or cultivator to insure the purchase of these implements by a number of farmers in each community.

It seems to be a very general condition that it is lack of information rather than lack of capital that prevents the more widespread use of modern farm equipment. Following the first season of demonstration work in the Province of Cebu more agricultural implements were sold in that province in six months than had been sold during the previous four years.

A very important feature of the demonstration work is in connection with the live-stock industry. There is urgent need that more attention be given to the building up of a prosperous live-stock industry in the Islands. This work includes the introduction of improved breeds of animals, better care of stock, and the control and eradication of diseases. The demonstration stations will be used as headquarters for breeding stock and from these stations breeding animals will be sent out through the provinces. The traveling inspectors furnish instruction to the farmers regarding the care and improvement of their live stock and report all outbreaks of animal disease.

The production of an improved and an increased food supply has already been touched upon under the subject of crop diversification. The importance of this matter can hardly be overestimated as it is the very foundation of the industrial prosperity of the Islands. It is a blot on our agricultural situation and hardly less than a disgrace to the Philippine farmer that the leading imports of the Islands are not only food products, but food products grown extensively within the Archipelago. This condition is a serious menace to the country and one that should by all means be remedied. The first work of the demonstration inspector is to impress upon the people the importance of producing on the farms sufficient food both for human beings and for domestic animals, and the demonstration plots will be largely used to show how this result can be accomplished.

In brief, the demonstration inspector acts in the capacity of a general adviser and assistant to the farmers of his district. The demonstration project is a measure designed to promote by simple and practical means the improvement of agricultural conditions in the province or islands which it covers. The above outline shows the general features of the work. Each project has its own problems and must be worked out in such a way as to fit in with local conditions. The projects thus far established have proven that this can be done, and the attitude of the farmers toward this work shows that it can be extended to other parts of the Islands.

DEMONSTRATION WORK IN THE PROVINCES AROUND MANILA.

By W. A. MACE, *Agricultural Inspector.*

It is estimated that the total area of land under cultivation at the present time in the Provinces of Bulacan, Rizal, Cavite, and Laguna is about 200,000 hectares. More than one-half of this area is planted to rice, which is by far the most important crop of this district. Other crops such as maize, abacá, sugar cane, and coconuts are grown very extensively in some localities in these provinces. Vegetable gardening is also an industry of considerable importance in a number of towns near Manila.

The general agricultural situation in this district around the city of Manila is somewhat different from that found in any other part of the Islands. One important factor in this situation is that the transportation facilities are such that produce can conveniently be taken to market at a very low cost. There are more than 250 kilometers of first-class roads and nearly 300 kilometers of second-class roads in this territory. The main lines of the Manila Railroad run through all of these provinces, while some of them have the benefit of additional branch lines. Many of the towns have excellent water transportation connecting them with Manila. In fact, no other section of the Islands is favored with such good transportation facilities as is the district around Manila.

A second factor, and one of great importance to the farmers, is the market. The city of Manila not only furnishes a market for all of the staple crops previously mentioned, but also for such secondary products as garden vegetables, fruits, poultry, eggs, etc. At the present time the supply of these secondary products is unsatisfactory with respect to quality and insufficient in quantity. The farmers of this district are missing, in a considerable degree, a golden opportunity; and the residents of Manila and other large towns in these provinces are unable to obtain the fresh vegetables and fruits, and good poultry and eggs of which there should be an abundant local supply. Any marked

improvement in quality will largely increase the demand for these products and will benefit not only the farmers but also the general public. An increase in the supply of fresh vegetables and fruits will tend to bring about a corresponding increase in the use of these healthful food products, a condition much to be desired.

A demonstration project has recently been established which includes the Provinces of Rizal, Laguna, Cavite, and Bulacan. This project is under the supervision of an agricultural inspector with three assistant inspectors detailed in the different provinces. The work of the demonstration project in the district around Manila will be carried on along the same general lines as all other demonstration projects. An effort will be made to develop and improve the production of the staple crops of the district, and to encourage the people to produce as far as possible their own food supply. In addition to this work, however, special attention will be given to market gardening and the poultry industry.

As a part of the work of this project a coöperative demonstration station has been established at Santa Cruz, Laguna. The provincial officials of Laguna first proposed the establishment of this station and have given the work the most cordial and effective support. A tract of land adjoining the provincial building at Santa Cruz, and having a flowing artesian well, has been set aside for the demonstration work and has been fenced by the province. This land is now being prepared and will first be planted to maize. At the next planting season a variety of crops will be planted.

Coöperators are now being secured in Rizal and Cavite, and the work will be extended into Laguna and Bulacan, with a view of having at least one demonstration plot in each town in these four provinces at the next planting season. The first work will be done with maize and garden vegetables, as these crops are generally grown throughout this district.

There is an excellent opportunity for carrying on effective demonstration work in the provinces around Manila. The farmers of his district are already beginning to take an interest in demonstration plots, and this interest should increase as the work begins to show results.

THE ILOILO-CAPIZ DEMONSTRATION PROJECT.

By SAM H. SHERARD, *Superintendent, Iloilo Demonstration Station.*

The Iloilo and Capiz demonstration and extension work was started in March, 1911. The work in this province up to the close of the calendar year 1911 was largely confined to the inspection of farms, seed distribution, and lecture work.

During the latter part of 1911 arrangements were made to carry on demonstration work in Iloilo and Capiz in coöperation with the Philippine Railway Company, and demonstration plots were secured. Work on these plots was confined almost entirely to one crop, maize. The planting of the demonstration plots was delayed on account of a severe drought which occurred during the latter part of 1911 and the first months of 1912. All of these plots were planted, however, in May and June. The method followed was to select the best seed available and to plant in "check rows" at distances of 1 meter, thus allowing for cultivation both ways. In addition to the plot work 23,500 ears of selected seed maize were purchased by the Bureau inspectors and paid for by the Philippine Railway Company. This seed maize was used on the demonstration plots, was distributed gratis to farmers planting under instructions, and was sold to others at the cost price of ₱2 per 100 ears. All of this seed was fumigated, thoroughly dried, and tested. The distribution of this selected seed has had a most important influence in increasing the production of good maize in Iloilo and Capiz. In connection with the demonstration plots and the seed distribution, the farm inspection work, lectures, and special work with tobacco were continued.

On July 1, 1912, the demonstration and extension work in Iloilo and Capiz was organized as a project. During the following month the Iloilo quarantine station of the Bureau of Agriculture was transferred to the demonstration division to be used as a demonstration station. This station is 2 kilometers from the city of Iloilo and is situated in a bend of the Jaro River. It contains 76,000 square meters of low and very fertile "gumbo"

soil. Owing to the nature of its use previous to being taken over for the demonstration work, it was in a very unsanitary condition and considerable time and money have been spent in preparing it for agricultural purposes. The entire station has been fenced and a large part of it has been platted and planted. Roads have been built, ditches dug, and the buildings cleaned out and repaired. In December 2 hectares were planted in maize, 800 square meters in cowpeas, and 500 square meters in pineapples. The remaining agricultural land on the station has been prepared and will be planted when the rains begin. The live stock at the station consists of 1 American stallion, 1 Nellore bull, 1 Berkshire boar, 1 billy goat, and 6 work bullocks.

The Iloilo station is now in splendid condition and will produce a sufficient quantity of good seed for distribution throughout the two provinces. It is a place to which farmers can come and see how crops should be planted and cared for, and where improved breeding animals are kept for service. This station promises to be an important factor in the demonstration work in Iloilo and Capiz.

From May to December, 1912, 14 maize demonstration plots were planted and harvested. At the present time 25 maize plots in Iloilo and 27 in Capiz are in excellent condition and will be ready for harvest in the near future. These plots vary in size from 500 square meters to 1.5 hectares and are scattered over a broad territory.

When it is considered that the average production of maize per hectare for the Philippine Islands is 8.22 cavans,[1] that maize planted the native way on river-bottom land in Panay gives a yield of only 26 cavans and 23 gantas per hectare, and that maize from selected and tested seed planted on this same river-bottom land and cultivated under the demonstration methods produced 95 cavans and 16 gantas per hectare, it is evident that this work is badly needed and that it produces results. The highest and lowest yields from the 14 plots harvested during September and October last were 98 cavans and 31 cavans, respectively, per hectare. On all of these plots the yield was from 25 to 150 per cent more than that produced on similar land in the same locality where the native methods were used.

The Filipino farmer, like the farmers of other countries, is inclined to be conservative when it comes to the question of introducing new methods. When the farmers' institutes were

[1] 1 cavan equals 75 liters.

held in Iloilo and Capiz last September, before the demonstration plots were harvested, several specimens of good and extra large ears of corn were used for illustrating seed selection. In every town and barrio where lectures were given the farmers would listen attentively, but after the lectures were finished they would smile and say, "Why, that is American maize; we can not raise big maize like that here." After the plots were harvested a second series of lectures was given on seed selection for the next crop. The large ears were again exhibited and they were all taken from the demonstration plots near the different towns where the talks were being made. In a number of cases the coöperators who grew this maize under the direction of the demonstration inspectors were called upon to explain that it was raised in the locality, and that it was "maiz del país" (native maize). There has since been no difficulty in obtaining coöperators.

The demonstration work has now been carried on in this district for about two years, and the farmers have about reached the point where they understand what the Bureau of Agriculture is trying to do for them. They are beginning to appreciate the work, and are learning to call on the demonstration inspectors for advice and assistance. The work is sufficiently advanced so that results can be seen, and the confidence of the farmers is being won.

It is stated by officials of the Philippine Railway that as a result of the demonstration work carried on by the Bureau of Agriculture in Panay more shelled maize was shipped into Iloilo from Capiz and way points during the months of August, September, and October, 1912, than had been shipped in the past three years. Inasmuch as the farmers can produce two crops of maize per year without irrigation, as this cereal is both a cash and a food crop, and as it can be grown on land that is not suitable for rice, it will be seen that the development of this industry is of great economic importance in Panay. Farmers are now growing maize in the Provinces of Iloilo and Capiz who never thought of planting it before the demonstration work was established.

COÖPERATIVE DEMONSTRATION WORK IN THE ISLAND OF CEBU.

By GEORGE G. WEATHERSBEE, *Agricultural Inspector.*

During the month of April, 1911, an agricultural inspector was detailed to the Province of Cebu for the purpose of making a thorough investigation of this province with a view of establishing in Cebu a system of coöperative agricultural demonstration work.

The Island of Cebu is one of the most densely populated islands of the Archipelago. Agriculturally it is one of the poorest, having large areas of semiarid rocky land and comparatively small areas of good agricultural land. The principal crop grown in Cebu is maize, while tobacco, coconuts, sugar cane, rice, and a number of other minor crops are also cultivated in different parts of the Islands. The methods used in Cebu in the cultivation of maize are primitive in the extreme. In many sections the crop is planted on steep hillsides, the method of planting being to dig a small hole in the ground with a pointed stick, plant the seeds, and then take no further action until the time of gathering the meager harvest. Other crops than maize receive somewhat more attention, but throughout the island there exists the most urgent need for the introduction of improved methods.

The first work of the inspector after his arrival in Cebu was to visit every municipality in the province and to gather all possible data relative to the existing situation.

On this inspection trip two or more days were spent in each town visited. Upon arrival in a town the inspector first visited the municipal officials and requested the president of the town to call a meeting of the principal farmers of that section for the following day. In most of the towns a small amount of maize and garden seeds were distributed to farmers who agreed to follow the instructions given in planting and caring for these seeds and to report results to the Bureau of Agriculture. When

it was possible to do so, a number of farms were visited and suggestions given to the owners regarding practical methods of improvement. The meetings called by the president were usually well attended. Talks were given by the inspector on various agricultural subjects, an effort being made to select such subjects as would be of particular interest to the farmers of the town in which the lecture was given. At each meeting a list was made of the principal farmers of the town, including data regarding the area of each farm, the number of work animals, the kind of crops raised, and any particular line of agricultural work that the farmer in question might wish to take up. The matter of forming agricultural associations was discussed and encouraged.

After this inspection was finished four of the principal towns in Cebu were selected as suitable places for starting demonstrations and coöperators were secured in each one of these towns.

In November, 1911, an arrangement was made to carry on demonstration work in coöperation with the Philippine Railway Company and to establish demonstration plots on land occupied by the railway right of way. The staple crops of the province were to be grown on these plots and the work was to be done by farmers whose land bordered on or was close to the plots. Transportation for the inspectors and office and seed room were furnished by the railway company, while commercial firms in the town of Cebu contributed agricultural implements and fertilizers. During the months of November and December, 12 maize plots, 2 sugar-cane plots, and 5 rice plots were selected and prepared for planting.

In connection with the demonstration plot work the agricultural inspectors are engaged in such other activities as may serve to promote the agricultural interests of the districts where they are employed.

During the period above mentioned a very creditable agricultural fair was held in the Province of Cebu in the town of Carcar. Nothing of the kind had ever been attempted before and great interest was taken by the people in this fair. All kinds of agricultural products were exhibited and there was keen rivalry for the prizes offered by the railway company for the best exhibits of different products. Good commercial exhibits of agricultural implements and fertilizers were also made and industrial exhibits were contributed by the schools. During the fair pamphlets and seeds were distributed and an illustrated lecture was given. The enthusiasm shown by the people in all

of the features of this fair indicated that results of permanent value were accomplished.

During the first half of the calendar year 1912 the Province of Cebu suffered from a prolonged and severe drought. Practically all demonstration work had to be abandoned during this period, although an attempt was made to plant a few of the plots, and in one or two instances where water was available excellent results were obtained. During this period of drought the inspectors were occupied in visiting farms, demonstrating methods of seed testing, and furnishing the farmers such other assistance as was possible.

With the coming of the rains in June planting of demonstration plots was immediately taken up. Sixteen plots were planted and this number was later increased to 28.

In the month of May, 1912, swarms of locusts appeared in different parts of Cebu and for nine month thereafter this province suffered from one of the most severe locust infestations in the history of the Islands. The inspector in charge of agricultural work in Cebu was detailed to assist in the locust campaign and devoted a great deal of time to this work. In the midst of this campaign the province was visited during the months of October and November by two extremely severe typhoons which devastated large sections of the island where demonstration work was under way. Following this storm a résumé of the work showed that of 28 demonstration plots planted 11 were harvested and the remaining 17 were destroyed by drought, locusts and the typhoons. The 11 plots that were harvested gave an average of 59.1 cavans of maize per hectare, which was 81 per cent higher than the yields on adjoining lands cultivated by the native methods.

It would be difficult to conceive of conditions more unfavorable than those under which the agricultural demonstration work in Cebu was carried on during the years 1911 and 1912. Within a period of twelve months the province was visited by most severe droughts, locust infestations, and two destructive typhoons. Planting was delayed, crops were damaged, and more than half of the plots were entirely destroyed. The fact that under these conditions definite and positive results were obtained is highly encouraging.

Following the typhoons of November and December, 1912, the planting of demonstration plots was again taken up. Most of the plots planted were on the land adjoining the railway. The crops planted on these plots were maize, cowpeas, tobacco,

and sweet potatoes. Twelve maize plots were planted in the following towns: Two in Simala, 2 in Ocaña, 2 in Carcar, 1 in Sibonga, 1 in Sangat, 1 in Naga, 1 in Minglanilla, 1 in Talisay, and 1 in Banao. The tobacco plots, 3 in number, were located at Carcar, Simala, and Argao. The sweet potato plots were in Simala and Carcar, while cowpeas were planted in Carcar and Naga. During February and March, 1913, 7 of the maize plots were harvested, giving an average yield of 50 cavans of shelled maize per hectare. The average yield of maize on fields adjoining the demonstration plots was 35 cavans per hectare.

The tobacco plots at Carcar and Samala have been harvested, but the yield has not yet been ascertained.

The plot of cowpeas at Naga was equally divided between "New Era" and "Clay" varieties. The former variety made a very vigorous growth and produced a fair crop of seed, but the latter was a failure. The cowpeas planted at Carcar, where the "Clay" variety was used, were also unsatisfactory.

The sweet-potato plots have not as yet been harvested. They consist of two varieties, American and Chinese, and data that will be obtained showing the relative yield of these two varieties will be of interest.

During the first quarter of the calendar year 1913, 5 maize plots, 1 tobacco plot, 1 sugar-cane plot, and 1 sweet-potato plot have been planted.

During the month of March the agricultural inspector in Cebu attended the maize demonstration held by the Bureau of Education in the city of Cebu and presented a good instructive exhibit, showing the nature of the demonstration work carried on in the province. This exhibit was illustrated by photographs and contained selected seed maize, implements, fumigation boxes, and other material. Bulletins and circulars were distributed to interested persons and inspectors were on hand to explain the different phases of the work. On March 24, at the request of the president of the town of Liloan, a maize exhibit was held at that place. Although weather conditions were unfavorable, about 150 people were present and an interesting meeting was held. The exhibit included various implements, seed maize, maize shellers, mills, and, in fact, everything required for the growing and milling of maize.

In connection with the work of the Cebu demonstration project a supply of vegetable seeds is kept on hand at all times as there is a steady demand for such seeds as radish, tomato, pechay,

peppers, and eggplants. These seeds are given away upon request. During the past three months some 300 fine, healthy papaya trees were distributed, and 150 pineapple suckers and a supply of sweet-potato plants were also given away.

The prospects for successful demonstration work in the Province of Cebu are very bright. The farmers now have a clear understanding of the object of the work, and the results obtained last season are beginning to show in improved farming methods. In all sections of the province fields are better planted and cared for than they ever were before. An increased sale of farm implements is a further indication of what is being accomplished by this work. During the past six months, since the demonstration work began to show results, more agricultural implements and machinery have been sold by one company in Cebu than had been sold during the previous four years.

A tract of land near the city of Cebu has been obtained for a demonstration station and an appropriation has been made for the buildings for this station. With the establishment of a central demonstration station and the extension of the plot work more generally throughout the province, the Cebu project will be in a position to rapidly enlarge its sphere of work and should have an important influence in the improvement of agricultural conditions throughout the province.

DEMONSTRATION WORK IN THE PROVINCE OF BATANGAS.

By H. T. NIELSEN, *Superintendent, Batangas Breeding and Demonstration Station.*

Preliminary arrangements for the establishment of coöperative demonstration work in the Province of Batangas were made early in 1912. In October the Batangas breeding and demonstration station was established and active work has been carried on since that time.

The Batangas station is an excellent example of the coöperative spirit that is now being shown in different sections in the work of promoting agricultural improvement. The municipality of Batangas furnished the tract of land, and the province fenced this land, constructed the necessary buildings, dug a well, and has supplied a part of the labor required for the operation of the station. The Bureau of Agriculture has furnished the superintendent and other employees, breeding animals, and equipment. As a result of this coöperation the people of the province and the municipality are keenly interested in the work that is being done.

The work in Batangas Province has consisted largely in arranging for demonstrations to be carried on in the future, most of them to start at the beginning of the rainy season. At the breeding station considerable crop-trial work has been finished up, owing to the coming on of the dry season. The horse-breeding work has been very satisfactory, the services to March 28 totaling 175 for the quarter, and this will likely be increased to 185 or 187 by the end of the month. There is still some difficulty in having sows brought to the station to be served by the Berkshire boar, 17 having been served since December 10 when the boar was received. An effort has been made to induce the owners of sows to bring them to the station, but with rather poor results.

In arranging the demonstration work in the province every municipality has been visited. It has been the policy to call on the officials of each municipality and try to interest them so

that they would help select the coöperators. This gave very satisfactory results in every town except one where there was no interest manifested and where no demonstrations have been arranged for so far. In carrying out this policy much credit is due to the assistant inspector who has shown good tact in meeting the municipal officials and commendable zeal and devotion in getting the work started.

Aside from the rice crop (which is important all over the province), Batangas may be divided into four parts, in each of which there is a very important or major crop. The western part is largely devoted to sugar cane; the northern or northeastern part to oranges; the eastern, in the neighborhood of San Juan de Bocboc, is being mainly planted to coconuts; the southern part around Loboo is principally a corn section. The central part, including the country between the towns of Lipa, Batangas, Taal, and Cuenca, grows rice, corn, and sugar cane largely, and oranges to a very considerable extent.

The things which are especially worthy of note are the following: The generally poor condition of a great many of the orange trees in the neighborhood of Santo Tomas and Tanauan, various things having contributed to this state of affairs; generally poor care is given the trees, which are neither pruned, sprayed, or cultivated in most cases; the long severe drought of 1911 and 1912 undoubtedly seriously weakened the trees so that disease and insects have found it easy to gain a foothold. Pruning and cultivation will help very materially in correcting the troubles.

The rich looking and highly productive soil of the eastern part of the province is striking. Its comparative inaccessibility militates decidedly against its development, although this section will undoubtedly make great progress with the opening of a first-class road, and possibly a spur of the Manila Railroad, into the territory.

The productivity of the soil in the neighborhood of Loboo is also worthy of note. There were seen many fine fields of corn which would yield far more than the Philippine average. The amount of corn on hand is also a striking feature, as there were great stacks of dry corn at nearly every house.

The western part is evidently generally prosperous, due very largely to good yields of sugar cane. Two modern sugar mills are to be installed in this part of the province, one on the Roxas estates at Nasugbu, and the other a coöperative affair at Balayan. Another interesting feature in this section is the apparently successful (and it is believed profitable) growing of bush cotton

between the towns of Balayan and Calaca. Several small fields were seen there and all looked quite well.

The great central part deserves comment principally on account of the large amount of land under cultivation. A very large percentage of the arable land is now being cultivated.

The demonstration work as arranged for comprises 40 trials or plots. They are distributed among crops as follows: Corn, 31 plots; rice, 3 plots; orange-tree prunning, 3 plots; sugar cane, Hawaiian varieties, 3 plots. The latter will probably have to be abandoned for the present, because there is no seed cane available. According to towns the distribution of plots is as follows:

Nasugbu	3
Tuy	2
Balayan	2
Calaca	2
Taal	3
Bauan	3
Alitagtag	2
Cuenca	2
Loboo	2
Ibaan	2
San Jose	4
San Juan de Bocboc	3
Rosario	1
Lipa	2
Tanauan	4
Santo Tomas	2
Talisay	1
Total	40

The corn-demonstration work is planned to give double comparisons. Two varieties are used in each trial, Moro and the native variety grown locally. Each variety is planted in the way customary in the neighborhood, and also in plots where the hills are 1 meter apart each way, and two stalks to the hill. The arrangement is as follows: Native corn, in hills 1 meter apart each way, 2 stalks per hill; Moro, 1 meter hills.

All the coöperators have been strongly urged to plow as deeply as possible.

Nearly all the farmers have been anxious to coöperate in rice work, but it has not seemed practicable to take up this work at present. At one place we were satisfied the rice was being planted too thickly, so a plot of thinner planting will be grown by the side of the other for comparison. Two growers will each

have a plot of deeply plowed land in comparison with plowing of the usual depth.

In the coöperation in prunning orange trees young trees have been selected, and an effort is being made to develop them into trees as symmetrical as possible. The coöperators also have agreed to cultivate them according to our directions. Part of the trees are left as found for a comparison. There appears to be very great opportunity for doing good in this field.

At the breeding station the corn work all turned out rather better than was expected. Moro and Iloilo white were the best in the trials comprising Moro, Iloilo White, Iloilo Yellow, Golden King, Yellow, 90-day, and Clarence Wonder. The planting was in 1 meter hills. Ninety-day and Yellow were unsatisfactory.

Of the other things planted on the station grounds, Rhodes grass has done very well and considerable seed has been saved. Guinea grass has been growing entirely satisfactorily all the while, and *Chloris virgata* No. 1682, Red amber 17548, Lyon bean, *Dolichos lablab,* Clay cowpea, Guar, and *Canavalia* sp. have all made a fairly satisfactory growth. Ants and plant lice have bothered all of the legumes except guar and *Canavalia.*

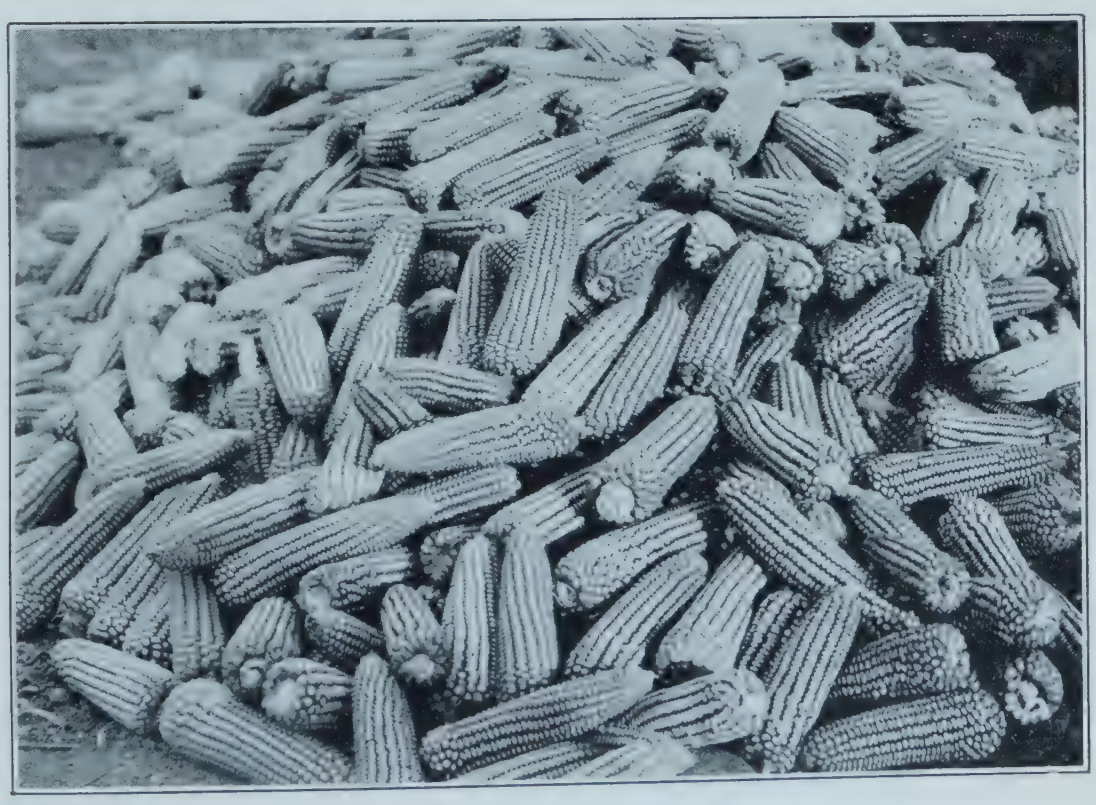
The breeding work at the station, under the direction of Mr. G. H. Burns, has been entirely satisfactory, and the stallions have been in the very pink of condition practically all of the time. As it is not at all uncommon for 10 and 12 mares to come to the station in one afternoon it has required tact and judgment to manage so as to prevent complaints. There seems to be no let up in the number of mares coming to the station, and only a few of them come from any distance. The stallions are being worked to their full capacity, and should probably have a rest, or at least lighter work, ere long. Many requests are received from Lipa and from Calaca and Balayan that one or two stallions be placed in each of those localities for a while, but there seems to be plenty of work here for the four stallions now at the station.



Maize plot at the Iloilo demonstration station.



(*a*) A Cebu demonstration plot.



(*b*) Maize grown on a Cebu demonstration plot.



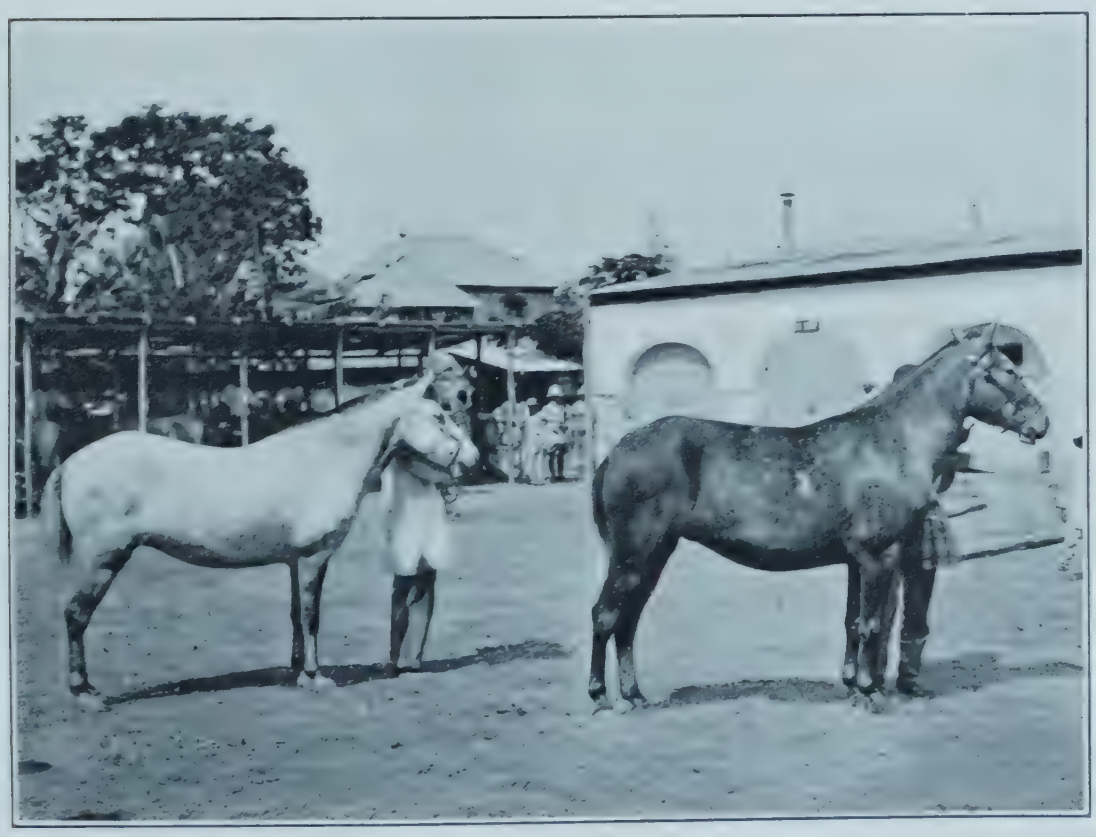
(*a*) Demonstration exhibit at the 1913 Iloilo fair.



(*b*) Products of the demonstration station shown at the 1913 Iloilo fair.



(*a*) "Beder, jr.," a mestizo stallion at the Batangas station.



(*b*) Native mares shown at the 1913 Batangas live-stock show.



Live stock shown at the 1913 Nueva Vizcaya agricultural fair.

DEMONSTRATION WORK IN THE MOUNTAIN PROVINCE AND NUEVA VIZCAYA.

By AUSTIN M. BURTON, *Agricultural Inspector.*

The territory covered by demonstration project No. 6, "Mountain Province and Nueva Vizcaya Demonstration Work," includes the Province of Nueva Vizcaya and the seven subprovinces of the Mountain Province, namely, Benguet, Lepanto, Amburayan, Bontoc, Kalinga, Ifugao, and Apayao. These two provinces include not only a very large area, but also widely varying conditions ranging from those of the tropical lowlands found in the coast regions of Amburayan and Apayao and in the interior valley of Nueva Vizcaya to the approximate temperate zone conditions found in the higher altitudes of the Mountain Province. There is, also, an equally wide difference in the people who live in these regions. Under these circumstances very careful judgment must be exercised in the methods used, and in the distribution and planting of seed over this large area in order that the work done and the seeds and plants distributed may be entirely suited to the local conditions of each particular district.

This project is supervised by an agricultural inspector, who organizes and directs the entire agricultural work of the two provinces and makes regular inspections of the territory covered by the project. Three assistant agricultural inspectors are now detailed in different subprovinces, and this number will be increased until each subprovince shall have at least one inspector. Each assistant inspector is expected to become thoroughly familiar with the people and the local conditions of his district and to carry out in detail the demonstration work within that district. In addition to the employees of the Bureau of Agriculture assigned to this work many of the local officials of these provinces are rendering highly efficient and valuable assistance.

The general plan of work for this project is the same as that of the demonstration projects in other parts of the Archipelago, namely, to promote the improvement of agricultural conditions by furnishing the farmers practical advice and assistance, and

by the establishment of coöperative demonstration plots in different localities. Every effort is made to adapt this work to the needs and the desires of the people, and to keep it within such limits that it may in all cases be practical. The crops worked with are largely those which are already cultivated, the main effort being to secure a wide distribution of selected seeds and plants, and the gradual introduction of better cultural methods.

In the subprovince of Benguet work was carried on by the Bureau of Agriculture for a number of years previous to the establishment of the demonstration project. The headquarters for this work was the Trinidad garden, where both investigational and demonstration work has been undertaken. As a demonstration station the Trinidad garden has accomplished excellent results. These results can now be seen in the flourishing gardens to be found throughout the municipality of Trinidad. The station has been used for the production of seeds and plants and as a headquarters for seed distribution. The people to whom these seeds were given have been visited by the superintendent of the garden and have been furnished instruction in methods of planting and culture. The thriving gardens of Trinidad now furnish an abundant supply of strawberries, peas, beans, radishes, turnips, carrots, lettuce, and other produce of the Temperate Zone. This produce is used and appreciated by the people themselves, and a great deal is also sold in the Baguio market, thus adding considerably to the income of the people who have been industrious and farsighted enough to take advantage of the opportunities offered them. The larger part of the area of the Trinidad garden has now been leased for a commercial market garden, the remainder being used for seed production. With the establishment of the demonstration project an effort is being made to carry throughout the subprovince of Benguet by means of seed distribution and demonstration plots the work that has been done in Trinidad.

In the subprovince of Bontoc the demonstration work has been greatly aided by the provincial governor, who has placed the work in the jail garden under our supervision and has furnished prison labor and an efficient foreman. This garden is well located, having good soil, irrigation, and drainage, and has produced very good yields of peas, beans, radishes, turnips, beets, lettuce, okra, squash, mustard, peppers, papaya and other crops. The flowers grown from Trinidad garden seed and distributed from propagation beds in Bontoc to different residents have done well and have helped to beautify the town. Ten loquat trees grown from seed

obtained in Sagada are thriving, and will soon be ready for transplanting. Some American sweet-potato plants taken from the Trinidad garden and planted in Bontoc during the first part of January, 1913, are growing well and appear promising. As the camotes (sweet potatoes) grown in the vicinity of Bontoc are poor both in quality and yield it is believed that the wide distribution of this improved variety will be very advantageous. In Camillas, Lepanto Subprovince; Natonin, Bontoc Subprovince; and Quiangan and Mayayao, Ifugao Subprovince, sweet potatoes from the Trinidad garden were planted for propagation and distribution, and are thriving in each place.

At the Constabulary post in Natonin, subprovince of Bontoc, very effective aid has been rendered by the officers in planting gardens under our supervision and also in distributing seeds and giving instructions to the people in their district. Some of the crops grown at Natonin are turnips, beans, peas, cowpeas, carrots, and corn.

Vegetable seeds have been furnished the Sagada Mission, where excellent results have already been obtained. The prospects are that a considerable amount of seed can be distributed from the Sagada garden next season.

In Lubuagan, subprovince of Kalinga, the work has been ably carried on by the lieutenant-governor, a man who has great influence among his people, and is interested in improving agricultural conditions. In Kalinga a large variety of seeds have been distributed and planted.

In Amburayan seeds of tomato, eggplant, corn, beans, radish, cabbage, and other vegetables have been distributed among the local officials of the different municipalities who have been given instruction and supervision in planting and caring for them. At present there are being distributed several hundred cacao seedlings in each municipality or township in those sections where conditions are apparently suited to this crop. A few trees are planted by each individual around his home and on this account it is expected that the trees will receive more care and attention and thrive better than would be the case were there a few large plantings made. In Bacun, a township of Amburayan, a number of Liberian coffee trees planted by the Bureau of Agriculture four years ago have borne their first crop. The trees are thrifty, have as yet shown no signs of blight, and the people like the coffee.

In Quiangan the supervising teacher has a large garden. The work in Quiangan has been considerably interfered with by the

depredations of rats, but even with this drawback good results have been obtained with beans, turnips, okra, lettuce, and radishes, and present indications are that cowpeas, corn, peas, and sweet potatoes will turn out well. The corn has been planted with a small lattice work of "runo" around each hill to keep the rats from eating the young shoots. The leaves of a bed of okra were attacked by leaf-eating beetles, but a stop was soon put to their depredations by the application of a Paris green and soap spray. The gardens in Quiangan are much noticed by the head men of the Ifugaos and seed is being raised for further distribution.

Work in Nueva Vizcaya, a very promising province, has been carried on by an assistant agricultural inspector, who distributed seed and furnished instructions to the local officials and influential people of the different sections and at the same time stimulated interest in the agricultural fair recently held. This inspector officiated as one of the judges of the exhibits at this fair and was thus given an opportunity to impress upon the people the fact that a steady improvement of their crops would be the result if they used the same care in selecting seeds as they used in the selection of their products for exhibit. Fortunately the principle of "like begets like" was well exemplified in the cattle and pigs exhibited, and by drawing a parallel between the animal and vegetable kingdoms the principle was impressed upon many more strongly than it would have been if advanced in the abstract, and will doubtless be followed by some of the more progressive farmers.

In developing the demonstration work in the Mountain Province and Nueva Vizcaya special attention will be given to the lines of work already mentioned. As the people of these provinces gradually come to have a better understanding of the value of improved methods, such new lines of work will be taken up as may best meet the requirements of the situation. At the present time arrangements are being made for the planting of seedbeds of coffee, cacao, and Hawaiian papaya in different localities. Using these seedbeds as a source of supply, plants will be as widely distributed as possible in sections adapted to these crops. Another line of work that has already been taken up is the distribution and planting of improved varieties of maize, the object being to develop a more general interest in the cultivation of maize, and to improve the quality and increase the yield of this important cereal in this section of the country.

EXTENSION WORK IN COÖPERATION WITH THE MANILA RAILROAD COMPANY.

By W. A. Mace, *Agricultural Inspector.*

Two kinds of demonstration and extension work are now being carried on in the United States: First, that which is done by the United States Government, the agricultural colleges, and other Government institutions through the medium of demonstration trains, farmers institutes, and coöperative demonstration work; second, that which is done by some of the most prominent railroad companies, principally by means of coöperative demonstration farms.

The State institutions combine their forces with those of the United States Department of Agriculture in all kinds of extension work. They also send demonstration trains through different sections and hold farmers institutes.

The agricultural demonstration trains which are sent out are generally accompanied by men who lecture on the different branches of agriculture. These trains are stocked with various kinds of agricultural products, statistical material, maps, charts, photographs, etc., which are displayed in the different towns where stops are made. The trains are usually sent out during the summer vacations of the colleges and universities, and a definite schedule is arranged and published in the various county newspapers for weeks before the trips are started.

The railroad companies employ a force of men who have agricultural training and practical experience to do farm demonstration work. These men go out and coöperate with the farmers in an effort to better agricultural conditions. Their salaries and all expenses are paid by the railroad company. They buy what are known to be the best varieties of seed of the different crops for a given locality and sell them to the farmer at cost prices. In coöperative work they strive to induce the farmer to use only up-to-date methods of farming, farm management, building of good roads, and anything which goes toward

the betterment of agriculture in every sense of the word. Some of the railroad companies have regular departments with a large force of employees who do nothing but this kind of educational work.

The reason for this interest in agriculture on the part of the railroad companies may be readily understood. As the farmer becomes better educated and works the soil in a manner which will give the best possible results, he has more produce to put on the market. The railroads naturally profit from the increased traffic. Thus each party is benefited by the coöperation. As an individual the farmer reaps, possibly, the greater profit, as the railroad people are teaching him things which will help him for years to come.

In view of the success which the railroads have had with this work in the United States, the Manila Railroad Company is now constructing a car for the use of the Bureau of Agriculture along the railway lines on the Island of Luzon.

The railroad company provides the car, keeps it in good condition, furnishes light and fuel for the attendants on the car, and transports it over the different lines. The Bureau of Agriculture equips the car with the proper exhibits and furnishes the necessary employees to care for and show the exhibits and lecture to the people in the different towns.

The car which is now being constructed by the Manila Railroad Company for this work is about 14 meters long and 3 meters wide. It will be lettered on each side "Agricultural Demonstration Coach." The interior arrangements provide for an aisle running the entire length of the car, the remaining space being used for exhibition purposes. Separating the aisle from the exhibits is a narrow show case about 3 feet in height. Entering the car from one end with the exhibit on the left-hand side the exhibition space is divided into sections. The first section will contain an agronomy exhibit; then comes in regular order horticultural work, seed distribution, publications, farm implements, and storeroom.

In the agronomy section will be exhibited specimens of the various staple crops grown in the Islands, illustrating improvements resulting from seed selection, plant breeding, use of modern implements, etc.

In horticulture will be shown the different horticultural tools, methods of grafting, budding, seed germination, and various methods of plant reproduction.

In addition to various kinds of seed for free distribution, methods of seed testing and some of the principles of seed selection are to be shown in the section for seeds.

Bureau of Agriculture publications and bulletins from the United States Department of Agriculture will be shown and distributed to persons interested in such printed matter.

The farm-implement section will contain such modern tools and implements as are available and suitable for use in these Islands.

The walls of the car will be covered with photographs, charts, maps, etc., showing the more important phases of agricultural work carried on by the Bureau of Agriculture.

In addition to the exhibit the car will be supplied with a lantern and several hundred lantern slides illustrating agricultural subjects. Meetings are to be held at night and illustrated lectures given on different subjects. Different employees of the Bureau of Agriculture will accompany the car for this lecture work.

It is believed that this demonstration car will tend to stimulate an interest on the part of the farmers in improved agricultural methods, and that it will be an important adjunct to the coöperative demonstration work.

THE NUEVA VIZCAYA AGRICULTURAL FAIR.

By AUSTIN M. BURTON, *Agricultural Inspector.*

The holding of agricultural fairs and exhibits is a popular, and in many ways valuable, means of educational work for the farmers. The number of such fairs in the Philippine Islands is increasing every year, and a marked improvement is being made in the quality, size, and number of exhibits. The following report of the Nueva Vizcaya Agricultural Fair recently held shows that these fairs are worthy of hearty support:

The Nueva Vizcaya Agricultural Fair held in Bayombong from March 7 to 9, 1913, inclusive, surpassed the expectations of its most ardent promoters. The people from different sections of the province took a lively interest in bringing their best produce for exhibit, and consequently a good idea of the productiveness of the province was given. The primary motives for holding the fair were to foster a friendly rivalry in agricultural matters between different sections of Nueva Vizcaya and to attract the attention of outside people to the advantages offered by this province. Nueva Vizcaya has a great deal of rich agricultural land which is uncultivated because there are not enough people to take it up and care for it.

There were exhibits for most of the principal crops of the Islands, among them being creditable displays of many varieties of rice, also exhibits of maize, sugar cane, tobacco, coffee, pineapples, plantains, bananas, camotes, yams, cacao, coconuts, papaya, squash, and a number of varieties of native beans. There were also good exhibits of tomatoes, eggplant, peanuts, potatoes, melons, onions, radish, turnips, endive and other plants not indigenous to the country, the seeds of many of which were distributed by the Bureau of Agriculture.

A considerable amount of industrial work done by the schools and also by private individuals was shown and attracted favorable attention. The industrial display consisted principally of articles of furniture, baskets, home weaving, and embroidered and knitted work.

Specimens of gold, copper, coal, fire clay, and several other minerals, also the miniature salt plant which was operated on

the exposition grounds, showed that Nueva Vizcaya is not poor in mineral resources.

The field and track meet between the different schools of the province was an interesting feature of the fair and was enjoyed by all.

In the live-stock exhibit, the advantage of breeding animals up to a higher type was well exemplified in the animals exhibited by Sr. Genaro Evaristo, of Dupax. The Angus-Chinese bull originally purchased at the Trinidad stock farm, is noticeably larger than the native cattle, and two of his progeny which were exhibited give promise of developing into a much improved type.

In the exhibit of pigs the improvement resulting from breeding to a thoroughbred Berkshire boar was remarkable. One sow with a litter of 9 husky young pigs attracted a great deal of attention and was justly awarded one of the premiums. The fact that as high as ₱25 has been offered for single members of this litter (now about 6 weeks old) may be taken as an indication of the esteem in which these pigs are held. Three other offspring from the same boar were also exhibited and were awarded a prize. They showed marked Berkshire characteristics, indicating the prepotency of the sire.

The farmers of Nueva Vizcaya are not only interested in raising the standard of their cattle and pigs, but are also devoting attention to the improvement of their horses. The provincial government obtained last year, through the Bureau of Agriculture, a New Zealand stallion which has been used for breeding purposes. A native mare and mestizo colt were shown; the latter, though but 1 month old, gives promise of developing into a fine animal.

The gold medal for the best exhibit as a whole was awarded to the town of Dupax. The exhibits from Bayombong and Solano were so creditable that it was only after long and serious deliberation by the committee on awards that Dupax was given this honor.

The success of this fair so far exceeded the expectations of its promoters and so much interest was taken by the different participants that there seems to be no doubt that the "Nueva Vizcaya Agricultural Fair" will become an annual event. The strong feeling of friendly rivalry built up between the different sections will doubtless result in the exhibits for the fair for next year being even better than were those of this year, in which case the fair will be well worth traveling a long distance to see.

FARMERS' COÖPERATIVE DEMONSTRATION WORK IN THE UNITED STATES.[1]

By H. T. EDWARDS, *Assistant to the Director.*

The farmers' coöperative demonstration work in the United States was first organized by the late Dr. Seaman A. Knapp in Texas in 1904.

It was announced at the time that the object and scope of the work would be to show by actual demonstrations on the farmer's own farm the value of better agricultural methods, the value of good seed and the value of practicing a few simple principles in growing a crop of cotton in sections of the country infested by the weevil. The primary object of this work when it was first organized was to give immediate relief to the farmers in those parts of the country that were suffering from the ravages of the cotton-boll weevil.

Conditions at this time in the weevil-infested sections of the United States were gloomy in the extreme. Cotton was the only cash crop and was largely produced on what is known as the "advance system." The farmers obtained credit for the necessary supplies to make the crop and at the end of the year the merchant or banker took the crop, sold it, paid the indebtedness and returned any remaining balance to the farmer. After the appearance of the weevil the merchants and bankers refused to make advances and the farmers were left without money, food or credit. The result was an agricultural and financial panic. Labor moved away, farms were abandoned and disaster was general throughout this section of the country.

The coöperative demonstration work of the United States Department of Agriculture was organized to relieve this situation, and the work of showing the farmers how to produce cotton in spite of the boll-weevil was undertaken. Agents were sent

[1] The Yearbook of the United States Department of Agriculture for 1911 contains a report, "Some Results of the Farmers' Coöperative Demonstration Work," by Bradford Knapp, Special Agent in charge of Farmers' Coöperative Demonstration Work, Bureau of Plant Industry, on which this article is based.

into the field to show the farmers how to raise a few acres of cotton under instructions prepared by the special agent in charge and at the same time how to increase their food supply by growing corn and planting home gardens. Immediate results were obtained. Cotton was raised in spite of the weevil and more corn was produced than ever before. Diversification of crops was advocated from the beginning, as it appeared certain that the weevil would sooner or later infest all of the cotton-growing sections of the South.

In seven years this work has had a remarkable growth. In 1912 some 600 agents were employed and practically 100,000 farmers in 13 different States were receiving instruction. The system has now become firmly established as a means of carrying helpful knowledge to the farmer on his own farm by placing a demonstration on his land and securing his coöperation in the adoption of the methods recommended.

The more important features of this work are as follows:

1. The direct personal contact of the local agent with the farmer.

2. The participation of the farmer in the demonstration work.

3. The practical certainty of success, under normal conditions, of the methods used.

The farmers' coöperative demonstration work is not essentially a work of investigation. The aim of this work is to take knowledge that has already been acquired by investigation and to give this knowledge the widest possible dissemination by means of demonstration. Its object is to convert the knowledge that has been obtained by experts into common practice of the farmers.

The farmers' coöperative demonstration work in the United States is demonstrating beyond question that cotton can be raised in spite of the cotton-boll weevil. From the very beginning of the work the demonstrators who have carefully followed instructions have, with few exceptions, produced a paying crop of cotton. Widely varying conditions are to be found in different sections of the cotton belt. It has been necessary, therefore, to vary the method used in the demonstration work to meet these differing conditions. In territory beyond the advance of the weevil efforts are being made to demonstrate better methods of crop production, the advantage of seed selection and the production of home supplies so as to be ready to meet the weevil when it comes.

In the majority of cases the actual damage done by the weevil is greatly overestimated as all reduction in the total yield of the

crop is invariably attributed to the weevil. As a matter of fact unfavorable weather conditions and pests other than the weevil have a large part to do with the fluctuations in crop production.

The results obtained by this work can not be easily tabulated or reduced to the form of mere statistics. Some of these results, however, are so important as to be particularly worthy of note. Data were collected from about 12,000 demonstrators representing an acreage in cotton of some 85,000 acres and in corn of about 75,000 acres. The following table shows the increase in yield of cotton and corn obtained on the demonstration farms over the average yield in a number of different States:

Increased average yield of cotton and corn on demonstration farms over the average yield in several Southern States in 1909 and 1910.

States.	Average yield of seed cotton per acre.				Average yield of corn per acre.			
	Demonstrators.		Entire State.		Demonstrators.		Entire State.	
	1909.	1910.	1909.	1910.	1909.	1910.	1909.	1910.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*
Eastern Texas	690.6	826.1			28.4	34.1		
Western Texas	547.5	578.4			21.8	31.5		
Texas (entire State)	633.3	710.4	375	425	25.4	32.8	14.7	20.6
Oklahoma	527.7	708.1	441	600	26.0	24.1	15.9	16.0
Louisiana	757.8	785.5	390	360	30.8	35.2	16.3	23.6
Arkansas	844.6	915.3	459	525	30.6	36.8	16.5	24.0
Mississippi	1,115.7	933.5	471	546	36.9	41.6	13.1	20.5
Alabama	1,138.4	1,220.2	426	480	33.2	41.4	11.9	18.0
Florida	597.5	572.0	330	330	21.0	23.0	11.3	13.0
Georgia	1,303.9	1,298.0	552	519	34.4	35.4	11.6	14.5
South Carolina	1,204.9	1,294.3	630	648	36.1	41.0	13.3	18.5
North Carolina	1,238.2	1,332.7	630	681	40.0	43.4	13.9	18.6
Virginia					41.0	46.5	20.6	25.5

Special attention has been given to the work of establishing diversified farming throughout different sections of the south.

The one-crop system has generally proven a failure as a permanent system of general farming. By the introduction of diversification it is possible for the farmer to produce most of his home supplies, such as vegetables, meat and other food products, to produce enough corn, hay and forage for a profitable live-stock business, to use leguminous crops for increasing the fertility of his soil, and to grow cotton as a cash crop. Under this system of farming a larger production per acre is obtained and the farmer is not dependent upon the fluctuating price of some one crop.

The work that has been done in arousing a widespread interest in the live-stock industry has been most important. It has been amply demonstrated that the South can produce the necessary feed for live-stock and in different sections the farmers are now

taking up dairying or hog raising as a result of the demonstration work.

The demonstration agents constantly advocate the use of more horsepower and less hand power on the farm. It is not unusual to find in different sections of the South where the demonstration work has been carried on for a few years that more farm tools and implements have been sold in the last two years than were sold in the twenty years before.

A great advance has been made in the coöperative feature of this work. This is amply demonstrated by the strong financial support which is now being received. The late Dr. Seaman A. Knapp once made the statement that this work first influenced the individual, next the community and finally the public opinion of the State. In the United States this third period of development has already been reached. For a number of years past individual associations of business men and farmers and county governments have been making voluntary contributions to assist the Department of Agriculture in extending the demonstration work. These contributions have been made in order that the work could be extended to sections where it could not otherwise be carried on because of lack of funds. With the large force of men now employed, with the actual results in increased crop production plentifully in evidence, and with the generally improved conditions in the sections where demonstration work has been carried on, public opinion has been strongly influenced. The States of Virginia, North Carolina, Alabama, Arkansas, Mississippi, and Texas have recently passed laws permitting county boards of supervisors to appropriate money for the purpose of coöperating in the demonstration work. The amounts appropriated in the different States vary from ₱10,000 to ₱50,000 per annum. In Alabama the appropriation has been such as to make it possible to place a local agent in every county. In North Carolina, Arkansas, and Texas the counties are paying at least half of the salary of the local agents.

In addition to the assistance furnished by different States and counties the agricultural colleges in different States are furnishing a great deal of assistance. The agents of the Department of Agriculture are everywhere endeavoring to coöperate with the agricultural colleges and experiment stations and all other forces working in the same general field.

To sum up the entire situation it may be stated that for every dollar appropriated by Congress for the support of the demonstration work in the Southern States an equivalent sum is devoted

to it from some other source. In other words, the people themselves are duplicating the appropriations made by the United States Government. All of this coöperative work is carried on in the most cordial and helpful manner and with practically no friction.

The farmers' coöperative demonstration work deals with the practical problem of producing crops upon the farm, and it takes to the farmer information helpful to him in a business way as well as information which enables him to obtain larger and better crops. The primary object of this work is to so guide the farmer that he may make the maximum yield at the minimum cost. The demonstration inspectors often help the farmers by practical suggestions of a business nature. A few hints as to how money may be saved by producing upon the farm supplies ordinarily purchased tends to create a desire for ownership of land. It has repeatedly been observed that the better class of tenants who have become demonstrators soon begin to consider the question of buying a farm. The reports from all agents show a tendency in this direction. Many demonstrators who were formerly in debt have subsequently reported that their indebtedness has been entirely wiped out and that they now have money in the bank. Reports also show that a large number of tenants, after several years of demonstration in coöperation with the Department, have purchased farms.

In the Yearbook of the United States Department of Agriculture for 1909 the late Dr. Knapp stated as follows:

> The farmers' coöperative demonstration work may be regarded as a method of increasing farm crops and as logically the first step toward a true uplift, or it may be considered a system of rural education for boys and adults by which a readjustment of country life can be effected and placed upon a higher plane of profit, comfort, culture, influence, and power.
>
> There is much knowledge applicable and helpful to husbandry that is annually worked out and made available by the scientist in the United States Department of Agriculture and in the State experiment stations and by individual farmers upon their farms, which is sufficient to readjust agriculture and place it upon a basis of greater profit, to reconstruct the rural home, and to give to country life an attraction, a dignity, and a potential influence it has never received. This body of knowledge can not be conveyed and delivered by a written message to the people in such a way that they will accept and adopt it. This can only be done by personal appeal and ocular demonstrations. This is the mission of the farmers' coöperative demonstration work, and it has justified its claims by the results.
>
> The demonstration method of reaching and influencing the men on the farms is destined ultimately to be adopted by most civilized nations as a part of a great system of rural education.



Trial grounds at the Singalong experiment station.

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CONTENTS.

Page.

Editorial 311
Annonaceous Possibilities for the Plant Breeder 312
Effect of the 1912 Drought and Typhoons and the May Typhoon of 1913 on the Production of Abacá (Manila hemp) 322
Recent Progress in Horticultural Work at the Singalong Experiment Station 329
The Italian Bees at Alabang, Rizal 335
The Financial Loss Occasioned by Harvesting Unripe Sugar Cane 340
Agricultural Conditions in the subprovince of Benguet, Mountain Province 345
Current Notes—July: The Coconut's Greatest Rival; Coconut Importation into the United States; Austrian Coconut Butter; Cocose; Another New Food Oil; Soya Oil; Peanuts; Citrus Culture in the United States; A New Fruit Extract; The Latest Theory of Sex Determination; A New Preserve; A Treatise on Mango; The Rice Water-Weevil in the United States; A New Guano Depot; Philippine Mango Exports; Erratum 348
Temperature and Rainfall—April 356

119341

ILLUSTRATIONS.

PLATE I. Trial grounds at the Singalong experiment station ..... *Frontispiece.*

Facing page—

II. (*a*), (*b*) Types of cherimoyas; carpels prominent 318
III. Type of cherimoya; carpels depressed 318
IV. (*a*) The custardapple; (*b*) The sugarapple 318
V. The soursop 318
VI. Biriba, shield-budded on mamon 318
VII. (*a*), (*b*), (*c*) Types of *Uvaria* 318
VIII. Apiary at Alabang, Rizal 336

EDITORIAL.

AGRICULTURAL CONSERVATISM.

Experimentation, elimination, selection—by these processes science moves on from point to point. Unfortunately, there are no short cuts for working out theories, laws, and solid facts regarding natural history subjects; it is easy enough to guess and theorize and correlate, and often there is no harm in so doing, but the conservative student looking for the genuine crystallized fact must needs try out, discard, and select.

When we ask a question of Nature—that is, make an experiment—we always receive not one but several answers; and thereby, through our limited powers of reasoning and selecting, comes the eternal trouble, as well as the pleasure, in scientific work. A new crop or fruit for the planter, a new way to destroy locusts or termites, a new kind of vegetable or flower, a new type of breeding animal—all these must be *tested* by some one before they have a right to go before the public as "inspected-and-passed" objects or ideas of value.

The world is rapidly—in the last two decades—coming to believe that this trying-out work should be done by Government institutions, the results to be given to the people as soon as it may be safe to do so. Naturally, then, the public has come to expect nothing but the plain, unvarnished truth regarding the results obtained through the Government's experimental work; opinions tinged with either optimism or pessimism do escape sometimes, but, in the long run, are usually harmful. A peso warned away from a losing venture is almost as good as the laboriously earned one; on the other hand, experience is worth something if it be not too discouraging. By the same token, also, it is obvious that the Government, rather than the private agriculturist, should meet the discouraging features and run the risk of financial loss in these efforts to learn just what is best.

Therefore, the practical evidences of the Bureau's work results, whether in the shape of a new vegetable, a new way to grow good maize, or abacá, or coconuts, a new way to control animal diseases or locust outbreaks, or any other improvement that makes for economy to the planter, stock owner, or agricultural investor, may always be accepted as the *best* for the *present*.

ANNONACEOUS POSSIBILITIES FOR THE PLANT BREEDER.[1]

By P. J. WESTER, *Horticulturist.*

One of the chronic complaints of the average Caucasian in the Tropics, the American in particular, is that of the inferiority and the scarcity of the fruits of the country in which he sojourns in comparison with those of the Temperate Zone. Unquestionably this attitude is to a very considerable extent governed by the circumstance of early associations, and because he has been accustomed to certain fruits, such as the apple, peach, and pear, since infancy, which differ greatly from the tropical fruits in composition, flavor, and aroma—even though it cannot be gainsaid that in the number of sorts and in their availability, the Temperate has the advantage over the Torrid Zone. This is partly due to the fact that the temperate fruits have been for centuries subject to breeding and good culture, and again, fruit culture in the Tropics has never been conducted along such lines and on such an extensive scale as in the native home of our complainant, not to mention the fact that so many of the tropical fruits do not have the keeping qualities possessed by several of their rivals in the North and South by which their season is greatly prolonged.

As a matter of fact, the equatorial belt has been far more generously treated by a kind Nature with a multitude of distinct species of plants bearing edible fruits than the rest of the world —with raw material of which good fruits are made, as it were. Let us not forget that the three fruits which have been considered the best in the world—the cherimoya, the pineapple, and the mangosteen—are all tropical in origin, not to speak of many others which are hardly inferior. Considering the care the trees

[1] For complementary articles on the annonaceous fruits by the same author consult "Pollination experiments with anonas," Bul. Torrey Bot. Club, 37, pp. 529–539, 1910. "A contribution to the Nomenclature of the Cultivated Anonas," Philippine Journal of Science, Vol. VII, No. 2, Sec. C, pp. 109–124, 1912. "Annonaceous Fruits and their Propagation," Philippine Agricultural Review, Vol. V, No. 6, pp. 298–304, 1912.

receive in the Tropics, the quality of the fruit produced is remarkable; that this fact again holds in store still greater promises for the patient and intelligent plant breeder, no one who is conversant with the subject will deny. Everything taken into consideration, the absence of good culture, intelligent selection of seed, and, above all else, for all practical purposes, vegetative propagation, excepting in the banana, pineapple, and ceriman, the quality of the tropical fruits may well be a source of wonder instead of an object of deprecation.

Many of the best varieties of the temperate fruits originated in fence corners, literally and figuratively speaking, and they owe their present-day existence and fame solely to the fact that they grew in a country where grafting and allied arts were known. In the Tropics, these means of propagation are still almost unknown and practically never in vogue. The more's the pity, for who can tell how many most excellent varieties of tropical fruits have therefore been lost to us?

One of the most interesting groups of plants to which the plant breeder in the Tropics may devote his attention is the genus *Annona,* including some 60 or more species, and the closely related *Rollinia,* with over 20 species, belonging to the family Annonaceæ, of which an unusually large number of species bear edible fruits. There is also one species of *Duguetia* and some belonging to the genus *Uvaria* whose fruits are known to be edible. The papaw, *Asimina triloba,* is the only plant of this family in the Temperate Zone that may be considered as having possibilities for the plant breeder. Altogether, it is doubtful whether there is any other genus which contains so many species having edible fruits as the genus *Annona.* Already Linné seems to have anticipated this when he created the genus for the name *Annona* signifies "provisions;" it is not, as generally believed, derived from the pre-Linnean name "Anona," which, after Linné, superseded *Annona,* in our days again being set aside for its older rival. Rumphius believed that "Anona" was a derivation of the Malay word Manoa or Menona, but Nieremberg, an older author, states that the name Anona was applied to all annonaceous fruits in Santo Domingo by the inhabitants. Considering that Oviedo already some two hundred years before Rumphius also referred to the sugarapple under the name "Hanon," sometimes spelled "Anon," there is but little doubt the name Anona is of American origin.

In connection with the fact that 9 fossil species of *Annona* have been discovered in Tertiary deposits in Europe, it is

interesting to note that nearly all the Annonas and all the Rollinias so far described are indigenous to the New World.

Several species of the genus *Annona* have long been in cultivation; but it seems that only one species of *Rollinia,* the biriba, has been domesticated, and this only locally where it is indigeneous; so far as the writer is aware the species has not been introduced into foreign countries until within a comparatively few years. Yet, Huber says that in Pará the biriba thrives better than any annonaceous fruit in cultivation in that country, succeeding well both in exposed and shaded situations. According to him it was already in cultivation in Pará in 1662.[1] Everything considered, it seems remarkable that such a superior fruit as the biriba is reported to be, and one so easily propagated and grown, has not, like several of the Annonas, become more widely distributed to other parts of the world.

The two genera *Annona* and *Rollinia* are very nearly related and many species in each genus closely resemble one another. That this close relationship is more than superficial is shown by the fact that at least one species of *Rollinia,* the biriba, makes a most satisfactory growth on the mamon (*A. glabra* L.), and the writer also, a year ago, experimentally budded the biriba on the soursop and the custardapple. These two combinations appear to be the less congenial, for, although the growth is healthy and normal, the vigor of the top is greatly reduced.

The quality and flavor of the many edible Annonas and Rollinias is highly divergent, some being sweet and others acid, some distinguished by the attractive coloring of their exterior and flesh, and others possessing a hard, shell-like rind that enhances the shipping qualities of the fruit, while in still others aroma and flavor are highly developed. Then again, certain species grow at high altitudes and are cold resistant—an invaluable characteristic in the subtropics visited by frosts; some possess unusual vigor; and still others inhabit swampy and inundated regions incapable of growing other fruits, while others succeed on high and well-drained land; and many deserve recognition for their decorative value; in fine, the variability of the fruits and the characteristics and habits of the species in the two genera under consideration are indicative of a wider range of potential possibilities of attainment by their intelligent hybridization than almost any other group of plants.

[1] Huber, J. Notas sobre a Patria e Distribuçao Arvores Fructiveras do Para. 1904, p. 391.

It is frequently said that there is nothing new under the sun, and the present instance is merely another verification of the truth of this old proverb; for it is interesting to note that the possibilities of amelioration of the wild species of *Annona* and *Rollinia* by selection, vegetative propagation, and improved cultivation were recognized nearly one hundred years ago by the botanist St. Hilaire. However, St. Hilaire was that many years in advance of his time, for the field is still practically virgin and it remains for this and future generations to realize his anticipations.

In 1908, at the subtropical laboratory, Miami, Fla., U. S. A., the writer successfully hybridized the cherimoya and the sugar-apple, the sugarapple and the custardapple, the cherimoya and the mamon, and the mamon and the sugarapple. Several hundred seedlings resulted from this work, part of which were planted out in 1910, the hybrids between the cherimoya and the sugarapple showing remarkable vigor and thriftiness. In 1911 hybrid seeds of the same combination from a cross made in 1910 were brought to the Philippines and the seeds sown in March of the same year. These hybrids exhibited the same remarkable vigor and some attained a height of 2.3 meters in one year and bloomed when they were 16 months old. No fruits resulted, however. This year, in the course of the reorganization work at Lamao, where the plants are growing, it became necessary to transplant the hybrids and their fruiting is on that account unfortunately delayed for another year.

Most of the notes incident to the preparation of this paper were collected in Washington, D. C., in 1909 and 1910, and it is a pleasure to the writer to acknowledge his indebtedness, for translations of many passages in foreign publications consulted upon the subject under consideration, to Dr. Audrey Goss, then of the Bureau of Plant Industry, United States Department of Agriculture, and now of the John Crerar Library of Chicago.

The writer is greatly interested in the study and the amelioration of the economic plants belonging to the family Annonaceæ and will esteem as a great favor the receipt of any information relative to these plants that readers of this paper may consider of interest. Seeds of Annonas, Rollinias, and Uvarias will also be gratefully received.

The collectors of herbarium material and traveling botanists naturally failed to find mature fruits of many species, and our information in regard to the fruits is, therefore, very meager. It is regrettable that they have so frequently neglected to state

the habit of the plant and its habitat; their descriptions, therefore, frequently fail to give any clue to the economic value of the plant, so important to the breeder. From what has been gleaned from the widely scattered literature on the annonaceous plants, those referred to below are believed to be species worthy of introduction and cultivation for breeding work, for testing as stocks for the species already in cultivation, or for ornamental purposes; it is quite probable that there are several others that, when better known, may also be found to be of more or less value. Common names have been given whenever found in the description of a species. Wherever one species has been found to have several popular names, the shorter or most attractive has been retained.

1. *Annona barteri* Benth.—A large tree, attaining a height of 15 meters, bearing a fruit 4 to 5 centimeters in diameter, growing on the banks of the River Niger, Africa.

2. *A. cacans* Warm.—Araticú Cagão. An attractive tree, upwards of 18 meters tall, with a fruit 8 to 10 centimeters in diameter, subglobose, greenish, glauco-pruinose; the flesh is edible. Araticú Cagão is indigenous to Brazil.

3. *A. cauliflora* Mart.—A vigorous tree, indigenous to the State of Bahia, Brazil, where it attains a height of 9 or more meters.

4. *A. cherimolia* Miller (*A. tripetala* Ait.).—Cherimoya. A tall shrub or small tree, 4.5 to 10 meters high, with ovate-oblong, velvety leaves. The fruit is variable in size and appearance from that of a large apple to 5,000 grams in weight, irregularly heart-shaped, greenish or yellowish, ferruginous tomentose, areoles more or less distinct, carpids depressed, equal or raised; the flesh is whitish, sweet, subacid, rich, melting, and aromatic. The cherimoya succeeds best on well-drained land and is a native of Ecuador, Colombia, Central America, and perhaps Mexico, but is now widely distributed throughout the Tropics and subtropics. The cherimoya is famed as one of the three most delicious fruits in the world. The extreme variability of this species is well illustrated in Plates II and III.

5. *A. cornifolia* St. Hil.—Brejo. A tall shrub, attaining a height of 4.5 meters; the fruit is about the size of an egg, ovate-globose, glabrous to subvillose, and orange red in color, the flesh sweet and edible. *A. cornifolia* is indigenous to southern Brazil and Paraguay.

6. *A. crassiflora* Mart. (*A. macrocarpa* Barb. Rodr.), (*A. rodriguesii* Barb. Rodr.).—Marolo. A shrub or tree, with tortuous branches, 3 to 6 meters tall, indigenous to Brazil, where it grows from sea level to an altitude of 800 meters. The fruit is globose, conical, 13 to 14 centimeters in diameter longitudinally, yellowish green, ferruginous tomentose, areolate, with prominent carpels; the flesh is white, sweet, of agreeable flavor, and aromatic. The fruit is eaten raw and also used in making a drink. There is a variety of this species the pulp of which is yellow instead of white.

7. *A. dioica* St. Hil. (*A. cuyabaensis* Barb. Rodr.).—A shrub, described as bearing a conical fruit about 4 centimeters in diameter, while according

to another author the species has a large fruit from which a very agreeable drink is prepared by the natives. This discrepancy of statements may be accounted for by there being different forms of the species. Indigenous to Brazil.

8. *A. diversifolia* Safford.—Ilama. A tree indigenous to Mexico, having a grayish-green fruit with cream-colored edible flesh.

9. *A. excelsa* H. B. K.—Ilama. A large tree of vigorous growth, 15 to 18 meters in height. The writer has failed to find any description of the fruit, which, however, must be of considerable value, since Foex mentions when it is in season and enumerates eight states in Mexico where the species is cultivated. The Ilama occurs in northwestern South America also and probably in Central America.

10. *A. fœtida* Mart.—A shrub, attaining a height of 3.5 meters or more, bearing a fruit of about the size of a goose egg, ovate to subglobose, dark rose red in color; the species is indigenous to Brazil. Inferentially Martius seemed to consider the fruit inedible, but otherwise very similar to

11. *A. furfuracea* St. Hil.—Araticú do Campo. A shrub 1 to 2 meters tall; the fruit has the size of an apple and is edible. Native of Brazil.

12. *A. geraensis* Barb. Rodr.—Marollinho. A shrub, 1 to 2 meters high, with yellow flowers, indigenous to Brazil; the fruit is described as large and aromatic with white flesh.

13. *A. glabra* L. (*A. palustris* L.), (*A. laurifolia* Dunal).—Mamon. A tall shrub or a small tree of vigorous growth, sometimes exceeding a height of 7.5 meters, with oblong-oval or obovate, glabrous, leathery leaves. The fruit is cordiform, 6 to 12 centimeters long, moderately smooth, undulate, yellowish or brownish; the flesh is an attractive rich, creamy yellow, and barely edible. The mamon, indigenous to tropical America and Africa, is, together with the sugarapple, custardapple, and the soursop, one of the oldest known species in the genus. The mamon has been found to be a satisfactory stock for the cherimoya, the custardapple, and the soursop, and appears promising for the biriba also. (See Plate VI.)

14. *A. hypoglauca* Mart.—A tree of vigorous growth, attaining a height of 6 to 9 meters, growing along the rivers in the State of Rio Negro, Brazil.

15. *A. ionophylla* Triana & Planch.—A species described from northwestern South America, where it grows at an altitude of 1,700 meters; the leaves of this species resemble those of the cherimoya and the flowers partake of those of the soursop. Unfortunately, there is no description of either the habit of the plant, its habitat, or the flowers.

16. *A. klanii* Pierre.—A tree, indigenous to Africa, attaining a height of 7 meters; the fruit is subrotund, 8 centimeters in longitudinal diameter.

17. *A. manirote* H. B. K.—Manirote. A shrub, about 3 meters tall, related to the soursop; the fruit is 15 centimeters in diameter, globose, muricate, and is edible. The manirote is indigenous to northwestern South America.

18. *A. muricata* L.—Soursop. A small handsome tree, 4 to 6 meters in height, with oblong-ovate or obovate leaves, dark green and shining; fruit irregularly ovate-oblong or conical, attaining a weight of 450 to sometimes exceeding 5,000 grams, greenish, with short, soft spines; flesh white, rather fibrous, subacid, juicy, and well flavored. The soursop is a very refreshing fruit eaten raw, and it makes excellent sherbet and a grateful cooling drink. The species is indigenous to the West Indies from whence it has that of *A. punctata*, which will be presently considered.

gradually spread to all parts of the Tropics. The soursop was the first species of the genus to be described and illustrated. (Plate V.)

19. *A. nitida* Mart.—A small tree, 6 meters tall, indigenous to inundated forests in Brazil.

20. *A. paludosa* Aubl.—Equinox. A low shrub, attaining a height of 1.5 meters; the fruit is of the size of an egg, ovate, tuberculate, and muricate, and yellowish in color; the flesh is whitish, juicy, melting, and of good flavor. The equinox is native to the marshy regions of Guiana.

21. *A. prestoei* Hemsley.—A robust tree with large leaves; the fruit is rather large, 10 centimeters in diameter, globose, fibrous and woody. Indigenous to tropical America.

22. *A. punctata* Aubl.—Pinanou. A tree, attaining a height of 7.5 meters, indigenous to Guiana, where it grows on the river banks; the fruit is ovate or subrotund, brownish, and punctate; the pulp is reddish and edible. Season, April and May.

23. *A. purpurea* Moç. et Sesse.—Soncoya. A tall, attractive shrub, upwards of 5 meters high. Opinions differ as to the value of the fruit of the soncoya, some pronouncing it superior to other Central American Annonas, while according to others the fruit is even deleterious, depending in all probability upon the fact that there is considerable variability in the species. The soncoya is a native of Mexico and Central America.

24. *A. quinduensis* H. B. K.—Cimarron. A shrub, 2 meters tall, indigenous to northwestern South America, where it ascends the Andes from an elevation of 1,000 to 2,340 meters. The fruit is of the size of an apricot. *A. quinduensis* was described as polygamous, but it seems likely that the description was made from abnormal flowers, and that the species is ordinarily hermaphroditic like its congeners. *A. dioica* St. Hil. owes its name to a similar mistake when that species was discovered.

25. *A. reticulata* L.—Custardapple. A small, rather attractive tree, 4.5 to 7.5 meters in height, with lanceolate, papery leaves. The fruit is 7.5 to 15 centimeters in diameter, cordiform, surface fairly smooth, greenish or yellowish with reddish reticulations. The flesh is a creamy yellow, rich, sweet, and melting, with a slight trace of acidity. The custardapple is indigenous to the American Tropics, but the species has long been well introduced throughout the entire equatorial belt. (Plate IV, *a*.)

26. *A. sanctæ-crucis* S. Moore.—Ata. A small tree, about 6 meters tall, of erect habit; the fruit is 6 centimeters in diameter, subglobose, tuberculate, greenish, of good flavor and well esteemed by the inhabitants. The ata is indigenous to Brazil.

27. *A. senegalensis* Pers. (*A. arenaria* Schum. & Thonn.), (*A. chrysophylla* Bojer.)—Anigli. A small shrub or tree, sometimes attaining a height of 8 meters, indigenous to a large part of tropical Africa from the coast and ascending the Ruwenzori to an altitude of 2,600 meters. The fruit of the better kinds is 4.5 centimeters in diameter, subglobose, surface yellowish to orange; the flesh is scant, but sweet and aromatic, and the fruit has by some travelers been very much lauded, while others have pronounced it valueless. The anigli is exceedingly variable and the following distinct subspecies have been described: *A. s. latifolia* Oliv., *glabrescens* Oliv., *cuneata* Oliv., and *subsessiliflora* Eng.

28. *A. sericea* Dunal.—A shrub or small tree, 2 to 6 meters in height, growing in inundated forests, bearing cordiform, tuberculate fruits 2.5 to



a.



b.

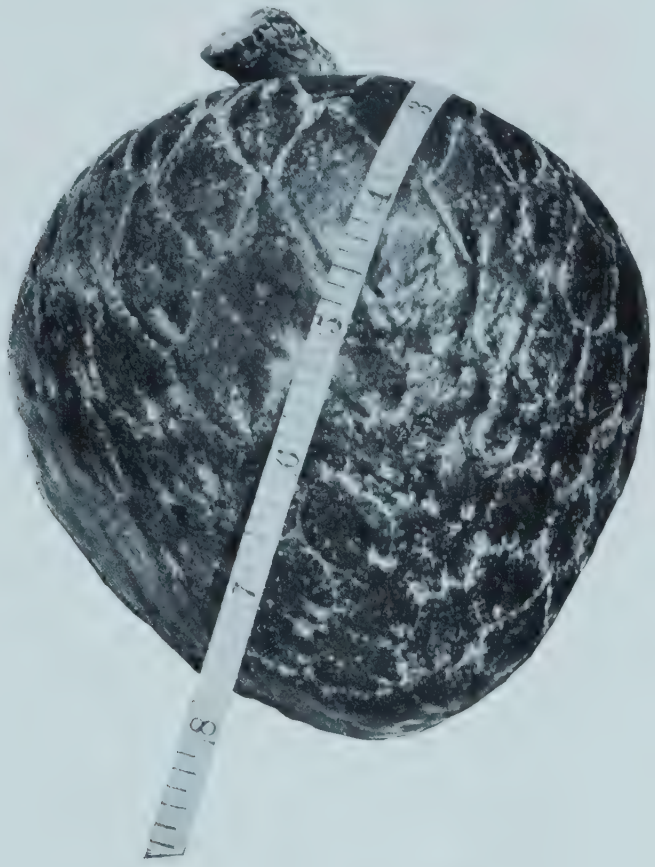
Types of cherimoyas (*Annona cherimolia* Miller), carpels prominent.

(Courtesy of Mr. David Fairchild, Bureau of Plant Industry, U. S. Dept. Agr.)

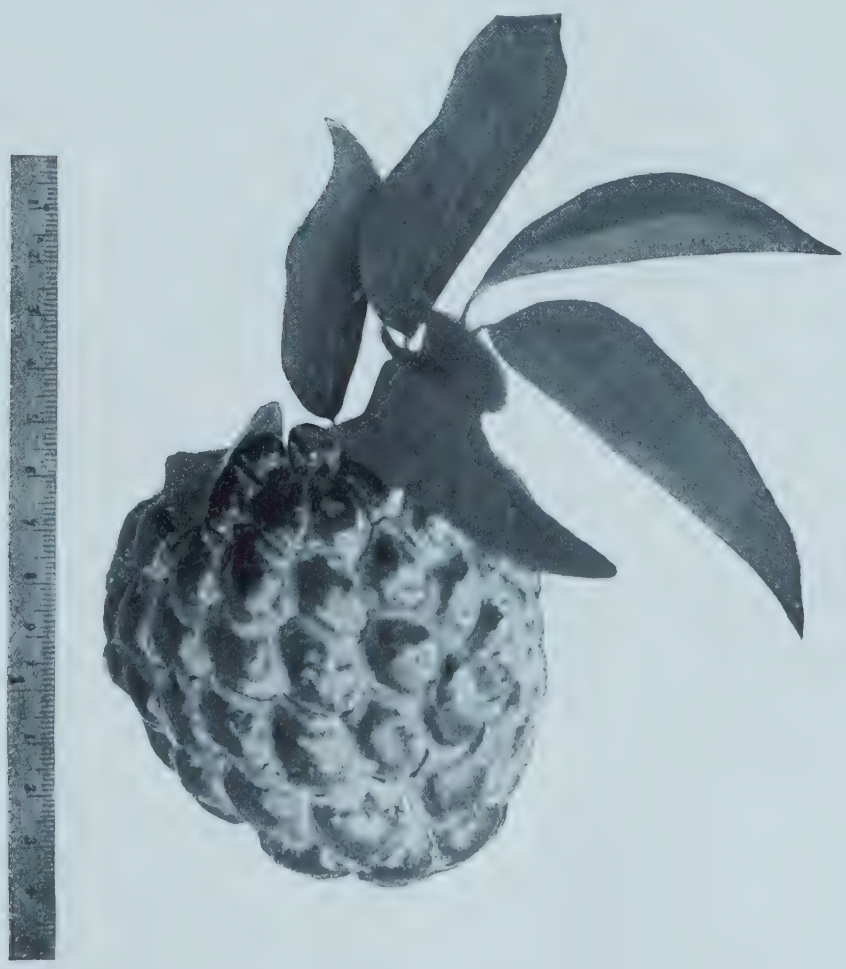


Type of cherimoya (*Annona cherimolia* Miller), carpels depressed.

(Courtesy of Mr. David Fairchild, Bureau of Plant Industry, U. S. Dept. Agr.)



(*a*) The custardapple, *Annona reticulata* L.



(*b*) The sugarapple, *Annona squamosa* L.

(Courtesy of Bureau of Science).



The soursop. *Annona muricata* L.

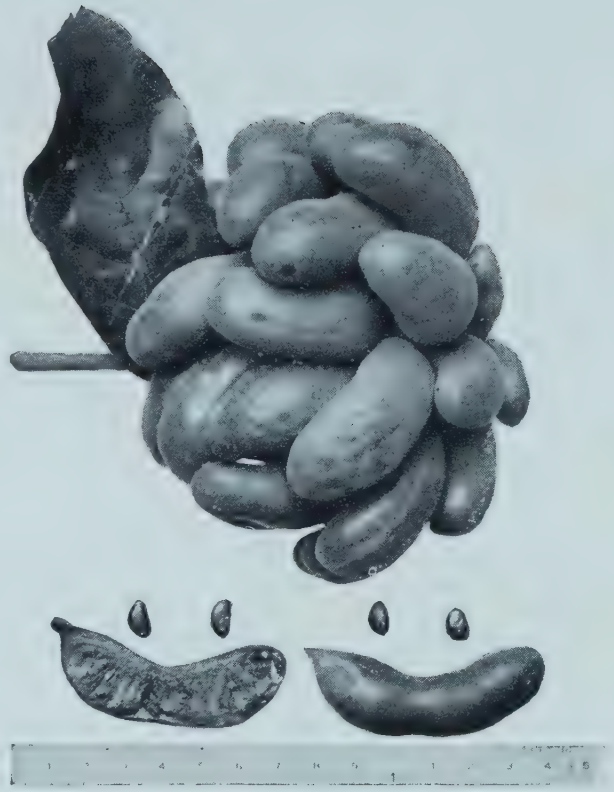
(Courtesy of Bureau of Science).



Biriba (*Rollinia orthopetala* A. DC.) shield-budded on Mamon (*Annona glabra* L.) (bud inserted in May, photographed in November).



(*a*) *Uvaria rufa* Blume. "Banauac."



(*b*) *Uvaria* sp. Susong Calabao.



(*c*) *Uvaria* sp.

Types of Philippine Uvarias.

3.5 centimeters in longitudinal diameter; found from the West Indies to Guiana and Brazil.

29. *A. spinescens* Mart.—Alagadisso. A shrub 3.5 meters high, growing on inundated land, indigenous to Brazil and southward. The fruit is 6 to 7.5 centimeters in diameter longitudinally, ovate, mucronate at apex, the surface faintly rose-colored, the flesh dry and insipid. The alagadisso is closely related to *A. cornifolia* St. Hil. A subspecies, var. *nutans* R. E. Fr., commonly called Araticú Ñu, that is, edible, has been described from Paraguay.

30. *A. squamosa* L.—Sugarapple. A tall shrub, 3 or more meters high, with oblong-ovate leaves, thin, and sparsely hairy; the fruit is irregularly heart shaped, 7.5 to 10 centimeters in diameter, tuberculate, greenish; the flesh is white, sweet, and delicately flavored, and the fruit is by some preferred to the cherimoya. The sugarapple is indigenous to tropical America, and has become more widely dispersed throughout the Tropics than any other species in the genus. Ever since the discovery of these five species, the cherimoya, the sugarapple, custardapple, soursop, and mamon, have been subject o an ever-increasing nomenclatorial confusion, the same popular name having been applied to two or more species with the inevitable result that even at this late day what is by one fruit grower considered to be a cherimoya is by another thought a custardapple and by a third a sugarapple, etc.[1] (Plate IV, *b*.)

31. *A. tenuiflora* Mart.—A tree, sometimes exceeding a height of 9 meters, indigenous to Brazil.

32. *A. uncinata* Sprague.—A tree 6 to 9 meters high; the fruit is ovoid-globose, uncinate, 4.5 centimeters in diameter; indigenous to Central America.

33. *A. vepretorum* Mart.—A tree indigenous to Brazil attaining a height of 7.5 meters; the fruit is 7.5 centimeters in diameter and has white edible flesh. *A. vepretorum* is related to *A. glabra* and *A. spinescens*.

34. *A. walkerii* S. Moore.—An erect shrub, 3 meters tall, indigenous to Brazil, where it grows in moist situations. The mature fruit is orange-colored and sweet.

35. *Rollinia cuspidata* Mart.—A tree attaining a height of 4.5 to 6 meters, growing along the banks of the Amazon River, Brazil.

36. *R. dolabripetala* (Raddi) St. Hil. (*R. longifolia* St. Hil.), (*A. xestropetala* Spreng.).—A tree, attaining a height of 6 meters, having a globose, scaly fruit, indigenous from Brazil and Guiana to the West Indies.

37. *R. edulis* Triana & Planch.—Tucuragua. A species bearing an edible fruit indigenous to northwestern South America, where it ascends the Andes to an altitude of 500 to 1,000 meters.

38. *R. emarginata* Schlecht. (*R. glaucescens* Sond.), (*R. sonderiana* Wlprs.).—Mirim. A slender, handsome shrub or a medium-sized tree, 3 to 10 meters high, with green coriaceous leaves; the fruit is globose, 2.5 centimeters in diameter or larger, and reported to be edible. The mirim is a very variable species, indigenous to Brazil and Paraguay.

39. *R. exsucca* A. DC. (*A. acutiflora* Mart.), (*A. exsucca* Dunal),

[1] For a full discussion of the nomenclature of these species consult the Philippine Journal of Science, Sec. C, Botany, Vol. VII, No. 2, 1912.

(*A. haematantha* Miq.).—An attractive tree of vigorous growth, 6 meters tall; the fruit is small and dry. Indigenous to Guiana.

40. *R. laurifolia* Schlecht.—Araticú do Mato. A tall tree of vigorous growth, attaining a height of 15 meters, indigenous to Brazil; the fruit is subglobose, of about the size of a chestnut, pubescent; the flesh white, mucilagenous, and sweet.

41. *R. mucosa* Baill. (*A. obtusiflora* Tuss.), (*A. mucosa* Jacq.), (*R. sieberi* A. DC.).—A small tree, 5 to 7.5 meters high, very similar in habit and appearance to the custardapple, with which species it was frequently confounded by the older botanists; the fruit is tuberculate and not so well flavored as that of the custardapple. Indigenous to tropical America.

42. *Rollinia orthopetala* A. DC.—Biriba. A tree of rapid and vigorous growth, attaining a height of 10 meters; the leaves are 20 to 29 centimeters long, oblong-oblanceolate, acuminate, the young growth reddish or ferruginous pubescent; the fruit is cordiform with raised carpellary areas; Martius states that the fruit sometimes grows as large as a child's head, but according to modern botanists this is an exaggeration; the flesh of the biriba is white, sweet, and deliciously flavored; in fact, this has by some writers been declared to be the best of all the Brazilian annonaceous fruits. The native habitat of the biriba is the inundated banks of the Amazon River, Brazil. (Plate VI.)

43. *R. parviflora* St. Hil. (*R. fagifolia* Schlecht.).—A shrub or small tree, 4.5 meters high, indigenous to Brazil. Two varieties of this species are recognized, var. *latifolia* and *angustifolia*.

44. *R. rufinervis* Triana & Planch.—A very ornamental plant with beach-like foliage, indigenous to northwestern South America.

45. *R. sylvatica* Mart. (*A. sylvatica* St. Hil.), (*A. silvestris* Vell.).—Araticú do Mato. A shrub or small tree 2 to 6 meters in height, with a fruit of about the size of a medium-sized apple, globose and tuberculate, slightly pubescent, rind thick, the flesh juicy and well flavored. Indigenous to Brazil.

46. *Asimina triloba* Dun.—Papaw. A small tree, from 4 to 12 meters in height, indigenous to the eastern part of the United States, from Florida to New York extending to Kansas in the West. The fruit is oblong, smooth, the flesh is edible, subacid, and very aromatic. The papaw is the only species in the genus producing an edible fruit and is rarely cultivated; it has been budded on the mamon and if it is sufficiently closely related to its tropical congeners it might be used to impart hardiness to them by hybridization.

47. *Duguetia longifolia* Baill. (*Anona longifolia* Aubl.).—Pinaioua. A shrub or small tree bearing an ovate, subrotund fruit as large as a medium-sized apple, punctate, reticulate, nearly smooth, skin thin; the flesh is reddish, gelatinous, and "delicate" and contains a large number of small seeds. Indigenous to Guiana and Perú.

The Philippines are the home of a number of species of Uvaria, none of which are cultivated. The fruits of some of these are edible and are picked and marketed by the Filipinos, but are as yet in a greatly undeveloped state. The identity of these species, except one, is doubtful, as no complete herbarium material of them has been available for determination.

48. *Uvaria rufa* Blume.—Banauac; Susong Calabao. Fruits oblong, reniform, 3, sometimes 4, centimeters in length, in bunches of 18 to 20 averaging 115 grams in weight; surface bright red, velvety, ferruginous pubescent; skin thin, brittle; flesh scant, whitish, juicy, aromatic, subacid without a trace of sugar; quality rather poor; seeds many. Season, September. (Plate VII, *a*.)

49. *Uvaria* sp.—Susong Calabao. Fruits oblong, semireniform, in bunches of 30 to 50, weighing 300 to 550 grams; surface orange yellow, velvety, ferruginous tomentose; skin thin, but rather tough; flesh scant, yellowish, granular, and sweet, without distinctive flavor, acrid near the seeds; quality rather poor. Season, October. (Plate VII, *b*.)

The fruit of both these species is marketed in Manila.

Aside from the cosmopolitan Annonas, which have long been cultivated in the Philippines, the Bureau of Agriculture has introduced within the last two years several other species, such as the mamon, *A. glabra* L., the biriba, *R. orthopetala* A. DC., both described above, and *A. montana* Macf., a shrub or tree indigenous to the West Indies. The fruit of the last species is globose, greenish, with soft spines, and said to be inedible; because of the fondness of dogs for the fruit, this species is in Porto Rico called "Anona de Perro." *A. paraguayensis* R. E. Fries, is a little-known species of which seeds have been received and plants reared within the last three months; the seed and foliage characters show this species to be a very near relative to *A. reticulata*. In addition to the above, two species of *Annona* and two of *Rollinia*, all unidentified, have been received and are being brought to fruition at the Lamao experiment station.

A method used by the writer since 1904 to force seedling plants into early fruiting may be of interest to other experimenters, since it is applicable to practically all fruits and is extremely simple. Stock plants of vigorous species are reared and set out in their permanent positions in the test orchard awaiting their "charges," as it were. The seedlings of new introductions are planted out close to the large stocks, as soon as they are sturdy enough to be set out in the open, and, when established, they are inarched upon the larger plant. After the union is well formed the top of the stock is gradually removed and with the vigorous and well-established root system of the older plant the little seedling is forced into fruiting far earlier than if it had been set out and sustained by its own root system only.

EFFECT OF THE 1912 DROUGHT AND TYPHOONS AND THE MAY TYPHOON OF 1913 ON PRODUCTION OF ABACÁ (MANILA HEMP).

By M. M. Saleeby, *Chief, Fiber Division.*

INTRODUCTORY STATEMENT.

A year ago this month the agricultural crops of the Philippine Islands in general were emerging from the deplorable ravages of a prolonged and unusually severe drought. This drought is generally conceded to have been the longest and severest in the memory of the present generation, and it was its uncommonness which alarmed both the producers and consumers of our agricultural crops, especially those produced for export. Of these export products abacá, copra, and sugar are by far the most important, and all have suffered to a greater or less extent from the drought in question.

In the fall of 1912 two rather severe typhoons occurred, which caused considerable damage to the crops in the provinces through which they passed. The October typhoon passed through Surigao, southern Leyte, southern and central Cebu, Bohol, northern Negros, and Capiz; and the November typhoon passed through southern Samar, northern Leyte, northern Cebu, and Capiz. It was fortunate for the abacá industry, however, that, of all the provinces hit by these typhoons, only one—Leyte—is a large producer of abacá.

Early in May of this year another typhoon occurred, which passed through Albay, southern Samar, Leyte, Mindoro, and the Ilocos Provinces, all of which, with the exception of the last two, are important producers of abacá.

Soon after the drought was over, and even before that time, the buyers and consumers of abacá were greatly concerned over its effect on the production of abacá. The prospects of a considerable shortage in the production of this important fiber and the strong demand for binder twine at the time caused by the prospects of good grain crops in the United States created an unusually strong demand for abacá. Even as early as June and July certain large consumers in the United States and Great

Britain attempted to determine the possible effect of the drought on the production of abacá by either sending representatives to the Philippines to investigate conditions on the ground or by delegating the task to their agents in Manila. In both instances the reports of such persons were based more on hearsay and on statements of some of the producers in certain affected districts than on actual conditions, and were consequently in most cases exaggerated and unreliable. Some reports, it is understood, estimated a general shortage from the drought alone at 50 to 60 per cent, which, if we were to add subsequent shortages from the typhoons, would cut down production to an almost negligible quantity.

In making such investigations three factors are absolutely necessary to enable a person to give an intelligent estimate. These are: First, a thorough knowledge of the condition of the plantations prior to the occurrence of the drought; second, sufficient training and experience in estimating the yield of fields of abacá; and, third, the reserving of a final opinion on the extent of damage until after the rains will have set in, in order to estimate more accurately the period necessary for the plants to recover and resume their normal condition of growth.

The aim of this paper is to give a detailed account of the extent of the damage to the abacá plantations in the Philippines as a result of the drought and typhoons of last year and the recent typhoon of May of this year, combined with as approximate an estimate of the production of abacá during the fiscal years 1913 and 1914 as it is possible to give. It is admitted that such estimates can only be approximate, due to the absence of a regular and reliable crop-reporting service and to the peculiar conduct of Filipino farmers in such adverse circumstances as are encountered during and after the occurrence of typhoons and droughts. The estimates given in this paper are based on personal investigation through the Provinces of southern Luzon and Leyte, and also on official reports from these and other provinces.

CONDITION OF PLANTATIONS PRIOR TO DROUGHT.[1]

Simultaneously with the gradual fall in the price of abacá since the beginning of 1908 came a gradual decline in the condition of the industry in general. The high prices paid for the fiber between 1903 and 1907 had caused so much enthusiasm on the

[1] Reproduced from the Annual Report of the Director of Agriculture for fiscal year 1912.

part of the producers that abacá was planted in any locality, under any conditions, and in any manner. While the price remained high the planters realized fair profits, but when the crash came many plantations were found to be so badly neglected, having poor soil, or managed under unfavorable conditions, as to make it impossible to realize any profits from them without the exercise of judicious methods of cultivation in some or a complete renewal of others. These methods, however, were not practised, and worse than that, whatever little attention had been given to the cultivation of the plants was gradually withdrawn, on the foolish plea that the price was too low to justify any such expense or trouble. In other words, instead of taking more interest in their farms and practicing more effective methods of cultivation and caring for the plants during the fall in price in order to increase the yield and better the quality of the product and make up for the difference in the price, the producers neglected their farms and looked upon any such efforts as unnecessary expense and wasted energy.

Such has been the general condition of the industry between 1908 and the present time, and there has always been the danger that a calamity in the form of a severe typhoon or a prolonged drought might seriously injure the "lates"[1] and set back the industry in general. What was feared happened in both of the above forms, but fortunately the damage that resulted has turned out to be not so disastrous as it might have been.

PRODUCTION OF ABACÁ BY PROVINCES.

The production of abacá was 171,880 and 159,473 metric tons during the fiscal years 1911 and 1912, respectively. The production during the present fiscal year (1913) is estimated at not less than 145,000 metric tons. The exports of abacá are, as a rule, between 5,000 and 10,000 tons less than the production, which quantity represents the amount consumed locally.

Of the 159,473 metric tons produced during the fiscal year 1912, 48,128 tons, or 30 per cent, are accredited to Albay Province; 20,343 tons, or 12.75 per cent, to Ambos Camarines; 20,178 tons, or 12.65 per cent, to Sorsogon; 22,920 tons, or 14.4 per cent, to Leyte; 13,386 tons, or 8.4 per cent, to Samar; 8,696 tons, or 5.5 per cent, to Moro; 7,693 tons, or 4.8 per cent, to Misamis; 3,767 tons, or 2.35 per cent, to Surigao; and 14,362 tons, or 9.15 per cent, to all other provinces. From the above

[1] Plantations.

figures it appears that southern Luzon, Leyte, and Samar produced, during the fiscal year 1912, about 125,000 tons out of a total of 159,000, or over 78 per cent.

EFFECT OF DROUGHT AND TYPHOONS ON PRODUCTION.

Southern Luzon provinces.—The provinces of southern Luzon, namely, Albay, Ambos Camarines, and Sorsogon, have suffered from the drought more than the rest of the abacá-producing provinces. The damage, however, is more apparent in the "lates" situated on the lowlands, and along the bases and sides of the low range of hills to the westward, which extends from Albay clear up to Camarines Norte. Even in these localities the few lates that, previous to the drought, had been kept in good condition, now stand out in marked contrast to the others that had been practically neglected. The object lesson demonstrated there is so plain that it is hoped it would help in emphasizing to the bulk of the producers the importance and advantage of keeping their lates properly cleaned and in good condition. The largest, and by far the best producing, abacá lates in southern Luzon are those located along the bases of the volcanoes Isarog, Iriga, Masarag, Mayon, and Bulusan. There the lates can be safely said to have practically escaped the drought, and they appear as prosperous now as ever before. The only damage reported from these districts consisted in the growth of the plants being retarded while the worst period of the drought lasted; but after that was over they again resumed their previous normal condition.

The majority of the lates, situated in the lowlands too far to prevent them from participating in the benefits from the occasional showers of rain which were not infrequent in the localities nearer to the above-mentioned mountains, are at present in a serious condition. The drought is not alone responsible for the present condition of these lates, for alongside of these are to be found other lates which have stood the drought and have emerged from it in a much less damaged state and in much better prospects for recovering and resuming their previous normal condition. The reason why these have not suffered nearly as much as the former, though undergoing the same adverse circumstances, was the fact that they had been kept in a fairly good condition prior to and during the period of drought. The careful and regular cleaning of the plants and the judicious methods of harvesting have succeeded in enabling the old plants as well as the young shoots to withstand the dry

spell and to resume their growth as soon as the rains set in. The short-sighted and ruinous methods practiced by the ignorant class of producers are, therefore, as responsible as the actual drought itself, if not more, for the present deplorable condition of most of the abacá lates.

In attempting to calculate the extent to which the abacá industry in the southern Luzon provinces was affected by the recent drought, it is, therefore, necessary to take into consideration the districts that were entirely, as well as those that were only partially, subjected to its influence. A thorough investigation along this line has convinced the writer that the various statements given out by several people interested in the abacá trade and fixing the expected shortage in production at 50 or 60 per cent are not well founded. It is, however, believed that a shortage of 25 to 30 per cent on last year's production can be reasonably expected. This shortage will probably extend until the end of the fiscal year 1914, after which conditions will probably improve until they are normal again about the beginning of 1915.[1]

Neither the October nor the November typhoon of 1912 touched any of the provinces of southern Luzon; and it was indeed very fortunate that they did not, as the majority of the lates were not in a condition to withstand the ravages of floods and strong winds.

The May typhoon of this year passed through Albay Province and is reported to have caused damages in certain parts to the extent of about 30 per cent, but this estimate is undoubtedly exaggerated. At the time this typhoon occurred the abacá plantations in Albay had either partially or entirely recovered from the effect of the previous year's drought, and consequently the damage could not have been as serious as it might have been had the typhoon occurred earlier. The shortage in production in this province caused by this typhoon will probably not amount to more than 15 per cent. Ambos Camarines and Sorsogon appear to have escaped this typhoon and no damage was reported.

Leyte and Samar.—The principal abacá districts in these two islands are the northern and northwestern parts of Samar and the northeastern and southern parts of Leyte. As in southern Luzon, so in Leyte and Samar, the damage caused by the drought of 1912 affected the lates on the lowlands and along the coast more than those lying farther back along the bases of the mountains. The shortage in the production of abacá from these

[1] Reproduced from a special report by the writer to the Director of Agriculture, dated October 14, 1912.

two islands as a result of the drought in question is less than that in southern Luzon, probably not exceeding 20 per cent, for the following reasons: First, a larger proportion of lates than in southern Luzon are located near or along the bases of the mountains, where occasional showers of rain were not infrequent even during the worst period of drought; and, second, it appeared that the drought in the former provinces was of less severity and duration than in the latter ones.

As to the two typhoons of 1912 and the May typhoon of 1913, both Leyte and Samar were less fortunate than the southern Luzon provinces. The October typhoon hit southern Leyte, the November one hit southern Samar and northern Leyte, and the May one of this year hit both southern Samar and Leyte. Leyte, therefore, suffered from these typhoons considerably more than Samar. As a result of these typhoons, therefore, the shortage in production of abacá during the fiscal year 1914 may be estimated at about 35 per cent in Leyte and about 20 per cent in Samar.

Other provinces.—Of the remaining provinces, Moro, Misamis, and Surigao are important in so far as the abacá crop is concerned. The drought occurred in all of them, but the degree of its severity and its duration varied, some being hit more severely than others. With the exception of Surigao, Bohol, Capiz, and Mindoro, they all escaped the typhoons which have occurred since last year's drought. The shortage in production as a result of both drought and typhoons cannot be estimated at more than 25 to 30 per cent.

SUMMARY.

In predicting the general production for the whole Islands during the fiscal years 1913 and 1914, we must not overlook three factors which have an important bearing on the question: First, the effect of the shortage in production in any one province on the total production; second, the beginning and duration of the period of time during which a certain shortage takes effect; and, third, the influence of such shortages in certain provinces on the production in other provinces which were not affected to any serious extent by either the drought or typhoons. Another factor which also appears to bear on the subject is a consideration of the period which elapsed between the drought and the typhoon or typhoons in any of the provinces affected by both. In certain instances, as Albay, the typhoon occurred almost one year after the drought, during which time a large number of

the plantations had recovered to a more or less extent from the effects of the latter, thus rendering it incorrect to estimate the total shortage by adding the two shortages caused by both drought and typhoon. From the estimates given in this paper it would appear that a shortage of about 35 per cent in the total production for the Islands can reasonably be expected to occur, taking effect during January, 1913, and extending to May or June, 1914. This estimate, however, may possibly be reduced, owing to the fact that a large number of plantations which had been almost entirely neglected before the recent considerable rise in the price of abacá are now being harvested to their limit, if not beyond.

Summing up the whole situation as it now stands, and taking into consideration every factor which tends to increase or lessen the effects of the drought and typhoons of 1912, it is the opinion of the writer that the production of abacá may be safely estimated at not less than 145,000 metric tons for the fiscal year 1913, or about 10 per cent less than in 1912. The production during the fiscal year 1914 will be considerably less, probably not exceeding 110,000 metric tons, distributed among the provinces as follows:[1] Albay, about 29,000 tons, or 40 per cent less than in 1912; Ambos Camarines, about 14,245 tons, or 30 per cent less; Sorsogon, about 14,125 tons, or 30 per cent less; Leyte, about 13,750 tons, or 40 per cent less; Samar, about 9,370 tons, or 30 per cent less; Moro, about 6,620 tons, or 25 per cent less; Misamis, about 5,770 tons, or 25 per cent less; Surigao, about 2,637 tons, or 30 per cent less; and all other provinces, about 10,100 tons, or 30 per cent less; thus making a total of 110,617 tons, or a shortage of 48,856 tons (about 30 per cent) over fiscal year 1912.

[1] Compare with production by provinces during fiscal year 1912, page 324.

RECENT PROGRESS IN HORTICULTURAL WORK AT THE SINGALONG EXPERIMENT STATION.

By O. W. Barrett, *Chief, Division of Horticulture.*

During the past six months the lines of horticultural work at the Singalong experiment station have been multiplied and broadened to a very great extent. The changes which have been necessary for the due progress of this branch of work of the division of horticulture have entailed but comparatively little extra expense in the line of labor, though they have necessarily required a large part of the time of the assistant horticulturist, Mr. H. H. Boyle; an agricultural inspector was detailed for a few weeks to help Mr. Boyle with the records; and from 6 to 8 laborers under 1 foreman have been employed. The broadening of the work is a noticeable feature and consists largely in the trying out of new varieties of vegetables and ornamentals for future distribution by the seed-distribution office of this division.

Soon after it became necessary to take up the new lines of work at the station, it was clearly evident that a proper fence should be constructed around the main propagation ground (something less than 1 hectare); the absence of such a fence heretofore had been responsible for considerable damage by stray dogs, pigs, and carabaos. Four hundred and twenty-five meters of woven wire fencing (1.42 meters high) with reënforced concrete posts has now been constructed.

A small addition to the old half-shade propagating shed was made to accommodate the extra number of seed flats which now number 340.

This new policy of experimental as well as propagation work necessitated the transfer to Lamao of a considerable number of fruit trees, shrubs, and plants; practically all of the old citrus trees which had become more or less diseased and infested with scale insects were taken up and set out in the unfenced portion of the grounds. A central roadway was laid out from the propagating sheds to San Andres Street. Next, the slightly raised

beds were laid off at right angles to this main avenue. A section was reserved for the wholesale propagation of such vegetables and ornamentals as are considered suitable for distribution (this is already becoming crowded). Another section was reserved for bananas, mulberries, etc., and the main portion was thrown open to the series of vegetable tests, and herein have been tried out such new varieties as could reasonably be expected to withstand the Philippine climate.

The old list of vegetables carried by the seed-distribution office comprised some 20 varieties of standard temperate vegetables, exclusive of beans, maize, and forage crops. It was highly desirable that this list should be doubled or even trebled, but at the same time it was realized that no variety should be distributed, especially to Filipino planters, until it had given indications of its adaptability to our local conditions. Accordingly, small quantities of seeds of many varieties of the ordinary easily grown vegetables offered by American, Australian, and European seed firms were obtained. In some cases only sufficient seed for the test at Singalong, costing only a few centavos per variety, was obtained; in other cases enough for testing at several experiment stations was secured. In round numbers, about 1,000 varieties of vegetables have been tested during the past six months, and of these about 200 have been "passed" as worthy of introduction. So far as possible simultaneous plantings of varieties of radish, for instance, were made in order to compare the general quality of the seeds of one dealer with those of another, and at the same time ascertain the comparative value of the varieties in a class with each other.

Records of planting, germination, productiveness, date of maturity, and resistance to insect pests, etc., have been carefully kept in every case. Moreover, in special cases where striking results have been obtained photographs have been taken showing on the same plate, when possible, two, three, or four varieties of vegetables planted on the same date, thus giving a very facile means of quick comparison. In spite of the fact that these tests were carried on during the middle and latter part of the dry season and with due regard to the economizing of water, comparatively few of the varieties have failed outright through dry-weather conditions. It has been practically impossible, however, to give a proper test to such groups of vegetables as cabbages, lettuce, turnips, etc., that require more shade or at least cloudy weather and a lower temperature for the greatest success. By the same token, great numbers of leaf-infesting

insects, which are always more abundant during the dry season on cucurbits (such as squash, cucumber, melons, etc.), have in a large measure checked or prohibited tests of this group of plants. Some 150 varieties of beans have been given a preliminary test at this station and most of these have been tried out also at the Lamao experiment station in Bataan, while a considerable number have been grown at the Iloilo demonstration station and at Trinidad gardens near Baguio, thereby giving a check on the results at the main station.

The soil of Singalong has been decidedly unsuited to high-class olericulture; but by means of mulching the young plants with rice straw and by using a considerable amount of stable manure and lumbang cake and a small quantity of chemical fertilizers, the poorness of the soil itself has been in a measure overcome, or rather offset, by the artificial stimulants.

It is worthy of note that during the past season practically no damage has resulted from the concentration of soil salts on the surface, although in the prolonged dry season of 1912 considerable trouble resulted from this cause.

In connection with the vegetable tests, which did not occupy more than two-thirds of the fenced area, it was found quite expedient and advisable to try out at the same time a good number of ornamentals. Special attention has been given to cannas, dahlias, gladioli, and miscellaneous pot and bedding bulbs and plants. While the propagating nurseries at Cementerio del Norte had already introduced a splendid lot of decorative shrubs and trees, at the beginning of these tests at Singalong it was scarcely possible to find more than 3 varieties of cannas, for instance, in the Manila gardens, although there is probably no more hardy a group of plants of first-class value for decoration than these. Practically no dahlias were in evidence; and, so far as we know, no gladioli. Of Crinums and Caladiums there were a very few hardy sorts, but none of the especially fine varieties which are practically as easy of cultivation as the old sorts. There are now in evidence at Singalong upwards of 150 varieties of cannas, most of which are beginning to flower; some 200 varieties of dahlias, about one-half of which have proven worthy of introduction; and about 125 varieties of gladioli, besides some 75 sorts of ornamental foliage and flowering bulbs.

It was clearly evident at the beginning of these tests that many of the introduced temperate sorts of dahlias, for instance, were suffering severely from the climatic conditions, and hence the interesting experiment of raising seedlings from well-recognized

strains has been made with highly satisfactory results. Although not over 5 per cent of the seedlings were expected to give flowers worthy of propagation, it was found that fully 20 per cent of the planted-out seedlings have given flowers worthy of a name. Furthermore, these seedlings, being born and bred, so to speak, in the Philippines, are evidently more at home under tropical conditions than the plants from the imported roots; in fact, some of the new seedlings which are now beginning to show character have outstripped all but the very best of the imported temperate sorts in point of luxuriance and "hardiness" of foliage. About 30 varieties have been selected thus far for propagation and have been named for the several experiment stations of the Bureau of Agriculture and for the provinces. Incidentally, it happens that the new "decorative" type dahlias, "Singalong" and "Rizal," are unsurpassed by any of the imported sorts and will compare very favorably with the best dahlia varieties of the world. Some difficulty is expected with the propagation of these plants during the rainy season; but by carrying them through as cuttings in raised beds, in pots, and in case of emergency in the new greenhouse which is soon to be constructed from special funds appropriated for the permanent buildings at Singalong, it is hoped that most of the varieties will come through safely; the tubers will be "dried off" and held over in the storehouse until about November, 1913.

Distribution of all the first-class ornamental varieties which have withstood these tests will be made as soon as possible, preference being given first to Government institutions, such as hospitals, demonstration stations, the larger schools, etc., after which provincial governors and municipal presidents will be presented with collections.

Incidentally, several thousand fruit-tree seedlings have been raised and sent out to the fruit station at Lamao; this in itself, considered merely as routine work, has been a "large order."

Another interesting feature which has developed in the past six weeks is an orchid shed. The Bureau had been carrying for some time a considerable collection of orchid plants either presented to it by individuals outside of the Bureau staff or collected by its various officials in different sections of the Archipelago, and to give these plants, some of which were decidedly valuable, a "square deal" the erection of a modest and very cheap temporary "half-shade" shelter became necessary. Some 250 fine plants are now establishing, or "settling," themselves.

Other remarkable points of progress in the horticultural work are:

The successful rooting of bamboo cuttings, a process which has hitherto been considered exceedingly difficult if not, even under greenhouse conditions, practically impossible.

The forced feeding of Amaryllis offsets; a very valuable collection of these immense, beautiful flowers was presented some months since by the United States Department of Agriculture, and although the propagation of Amaryllis bulbs is considered so difficult that "flowering-size" bulbs retail at from ₱3 to ₱5 each in the United States and Europe, a special method of treatment has been hit upon by Mr. Boyle whereby not only the mother bulbs are fully recuperated after the great strain upon their vitality at the flowering season, but also the daughter bulbs (which were very small and weak upon receipt) have now been "fed up" on a special diet until it is believed they will be ready for distribution within a few months; from the original 45 mature bulbs received from Washington, D. C., fully 500 young bulbs will be ready for distribution within a few months and about 1,000 of a smaller size will be ready next year if they can be kept in as vigorous a condition as at present; and beyond this, hybrid seedlings are now being raised from a "cross" made by the writer between a near-white and dark-red pair of plants.

The saving of a rare lot of grafted India mango plants which arrived in Manila in a dead or dying condition; although there is thus far no suitable greenhouse for keeping sick plants in a saturated atmosphere, an improvised moisture chamber was constructed about this valuable collection and nearly all of the plants have been kept alive, while most of them are now throwing out new "flushes."

The most important collections of plants now in various stages of propagation at Singalong are:

A splendid collection of mulberries gathered from the far corners of the earth; many of the new varieties, particularly those presented by Mr. P. J. Wester, horticulturist of the Bureau, from his own place in Florida, have shown a very marked superiority over the old variety which has hitherto been propagated at and distributed wholesale from the Lamao experiment station.

A very large collection of bananas and plantains has been "started" either from roots or seeds; at present there are nearly 200 numbers (probably over 100 distinct varieties) of this class of plants in evidence at Singalong—35 numbers having been sent on to the permanent testing grounds at the Alabang stock farm,

where it is hoped the largest and best collection of Musas in the world will soon be on exhibition.

A large collection of introduced and native yams (*Dioscorea* spp.)

A large collection of South American fruits and economic plants, seeds of which have been recently presented by Government stations in Argentina, Paraguay, Chile, and Brazil.

A collection of home-grown Coleus, numbering probably 100 varieties, which have been raised at practically no expense; the cream of the lot will go far toward helping out the deplorable shortage of good bedding plants for the "Manila beautiful" work.

In short, this station has probably turned out more "results," and accomplished the same more economically and more quickly, than any other institution of its size in the world in the same period of time.

THE ITALIAN BEES AT ALABANG, RIZAL.

By C. H. Schultz, *Veterinarian. Alabang Research Laboratory, Rizal.*

During the last days of November, 1912, two hives of imported Italian bees were sent from Singalong, Manila, to Mr. Thomas L. Bean, at Alabang, Rizal. In December they were placed under the care of the writer.

In a grove of ipel-ipel trees (*Lucæna glauca*) near the laboratory a shed was prepared with a level cement floor surrounded by a gutter to keep ants away; over it a good iron roof of ample proportions gives protection from rain and sun. The hives face north and are exposed to the sun only during the early morning hours.

The bee boxes, ordinary rectangular frame hives, hold 10 frames, each 4.32 decimeters ($17\frac{1}{8}$ inches) long, 2.03 decimeters (8 inches) deep (inside measurements), and 3.50 centimeters ($1\frac{3}{8}$ inches) wide; they are covered by flat boards with cleats; no supers are used, the number of bees being too small. This type of hive is in common use on bee ranches in California and Oregon.

After the bees had become accustomed to their new location the colonies were examined. A nicely colored, large Italian queen bee, three frames of worker brood, and three entire frames of drone combs were found in one hive. The large number of drones at once indicated that the queen was old and scarcely able to keep up a thrifty swarm. The colony was well supplied with honey and bee bread, and the combs were old but straight.

In the second hive no queen was found, only worker brood and a great number of capped drone cells; worker bees and drones were numerous. Abundant honey and beebread was stored in good straight combs; most of the brood combs were dark and showed that they had been in use several seasons. The last drones matured December 2, so that the last eggs must have been deposited about November 10; the colony had evidently been without a queen since then.

The bees in the first hive were nicely colored; drones and queen had the appearance of pure-bred Italian bees. The bees

in the second hive were darker, the drones almost black, probably from a queen of mixed breeding. Both colonies were gentle and permitted handling without becoming vicious—a very desirable characteristic.

The amount of honey gathered and stored between December 15 and January 10 was remarkable, when the small number of field bees is taken into consideration. Pollen was continually being brought in, so that beebread is abundant.

When the nights became cooler, the bees left the hive late in the morning. The honey flow ceased about the 12th day of January. The workers then summarily disposed of the drones, so that the number of bees was suddenly greatly reduced. The temperature in the brood chambers was found to be as low as 35.4° C. To remedy this serious condition, bee space over the bottom boards was reduced to 95 millimeters ($\frac{3}{8}$ inch); oil cloth was placed over the frames and the entrances were contracted to 7.6 centimeters or 1.01 decimeters (3 or 4 inches). This increased the temperature in the hives to a point which is favorable for the rearing of brood.

Although some days have been hot and sultry, the bees have never been uncomfortable; the work of caring for the young is carried on with greater regularity and the field force flies out earlier.

The temperatures in our locality are fairly constant and not subject to great sudden changes; careful consideration of the local conditions and the behavior of the swarms will soon demonstrate the type of hive that should be adopted.

At Alabang strong easterly winds blow across the lake almost daily during several months, which is a drawback, as it prevents the bees from going out regularly. They work best in the early morning hours and rest during the middle of the day, often resuming their flights late in the afternoon.

The honey the busy workers brought in is of a light amber color, nicely flavored, and of very good quality. Attempts made to locate plants that were especially productive of honey and pollen have, so far, not been successful. Artificial feeding will, it appears, never be required, if the beekeeper is careful in the management of his swarms.

The colonies are free from parasites. At one time red and white ants gained entrance to one hive; regulating the water level in the gutter soon stopped this annoyance. Some bees were caught by birds, some of the young queens being doubtless lost in this manner, a common complaint on all bee ranches.



The Apiary at Alabang, Rizal.

The problem arising when the Ligurian bees were placed in the writer's hands was exceedingly simple, but the solution proved difficult. It was necessary to raise young queens and mate them before the drones were destroyed or the only remaining queen was superseded by her workers. If this could be accomplished, the Italians were saved; if not, these nicely colored, gentle honey gatherers were doomed.

On December 4, the queenless colony was given two frames containing young brood and eggs; five queen cells were accepted, and from these four queens were raised, one of which was not perfectly developed. Two queens were caged. The young queen was successfully introduced (by Pond-Simmin's method) on December 22. Although drones were still flying in great numbers from this hive and the young queen was observed to fly out several times, it was not until January 21 that she began to deposit eggs.

Why twenty-five days should be required before the young queen began her duties in the hive cannot be explained.

A nucleus hive had been started on January 3. Although young queens were introduced and readily accepted on three different occasions, not one became a fertile mother. One queen was lost while flying; another remained in the hive for thirty-five days, made several flights when drones were present, but was never mated and never deposited eggs. It should be remembered that in temperate climates the drones are usually killed during the months of August and September, while here they were driven out during January. They were tolerated because their services were needed.

The number of field bees decreased in an alarming manner during January and February, because the old queen laid but few eggs. This decrease of the field forces required careful handling of the hives. The weaker hives were placed on the stands of the strongest hive every third day, so that the returning bees would supply the colonies in rotation. A bee bringing home a load can usually enter any hive, especially a hive that is in need of workers.

During this period of great scarcity of workers thermometers were placed over the brood frames and the small colonies helped along by carefully supervising every minute detail. For three weeks the situation was critical. In the midddle of February the apiary received the first recruits from the young queen.

To rear a queen in December and have her go out on a fruitful mating flight during January is a performance that a beekeeper

in a temperate climate will scarcely believe. Nevertheless, it did occur and saved the bees.

The young queen is a good producer and lays eggs in compact masses; her progeny is nicely colored, of good size, and very tractable. Her hive, perhaps the first colony of Italian bees raised in the Islands, is at present in first-class condition and a welcome addition to the apiary.

Since then the number of workers has steadily increased. The young queen may not lay drone eggs until next fall, in which case it will be impossible to mate more queens. The old queen will lay drone eggs; but her workers realized that she should be replaced and they tried to supersede her. In order to protect this valuable mother bee, she was caged and all emergency queen cells that were started during her absence were promptly destroyed. Only when spring activity in the hive could be noted was the queen again introduced. Thirty seconds after she walked down the combs, a peculiar "hum" from the entire colony could be heard; she was recognized and was gladly accepted. Her hive was then stimulated by judicious feeding; new foundation was placed in the midddle frames and when egg laying was again under way, a drone comb previously cleaned out and warmed up in the other hive was put in place between the newly used brood frames.

After a few days eggs were found in this drone comb, and the first males of the season appeared on April 10.

Since the date could be foretold, queen cells were started at the proper time, so that to-day the two new hives have drones, young queens, and a liberal amount of field bees—a very good start so early in the season. The young queen can furnish brood for the two nucleus hives, and by careful handling the old queen will again produce fertile eggs for a limited period and drone eggs in greater numbers. These pure-bred drones will fertilize the young queens and, climatic conditions being favorable, the number of hives can be increased. It will be necessary to look carefully after all the details, or the workers will supersede the old queen so valuable for propagating purposes.

At present the apiary contains the following: One hive with the imported Italian queen; 1 hive with a very prolific young queen; 2 nucleus hives with virgin queens and drones and workers in abundance.

All these hives are in a thrifty condition. The imported queen will be retained as long as possible. Young queens can be raised without difficulty. They are kept on hand in cages ready for emergencies.

The question of the propagation of Italian bees in the Philippine Islands has, therefore, been answered in the affirmative. It must now be ascertained whether an apiary can be made a commercial success or not. Locations and conditions appear to be favorable, and the introduction of this industry will materially add to the contentment and prosperity of the population.

It is to be hoped that further experiments on a larger scale will show as desirable results as the first attempts at apiculture at Alabang.

THE FINANCIAL LOSS OCCASIONED BY HARVESTING UNRIPE SUGAR CANE.[1]

By D. S. PRATT and L. W. THURLOW.
(From the Division of Organic Chemistry, Bureau of Science, Manila, P. I.)

The composition of the juice found in sugar cane (*Saccharum officinarum*) undergoes a progressive change as the plant matures, attaining a maximum sucrose content between ten and thirteen months after planting. The purity of the juice, or proportion of cane sugar to total solids, at this period of growth is greater than at any other stage of development. The great importance of employing juice of high purity is so well understood by all sugar manufacturers employing modern centrifugal mills that further comment would be superfluous were it not for the fact that practically all Philippine sugar is still made in mills not possessing these features and controlled by *hacenderos* [2] who have not appreciated the direct relation existing between purity of original juice and quality of final product. It is for the benefit of such planters that this paper is written.

When cane juice is boiled in open kettles, and the massecuite dried without the use of centrifugal machines, the polarization of the resulting sugar closely approximates that of the original juice, but is never higher. It is thus impossible for the planter to make high-grade sugar when he crushes his cane before it has reached at least approximate maturity. Ignoring this fundamental fact has yearly resulted in heavy loss to many plantations. It cannot be denied that circumstances often arise over which the *hacendero* has no control and that make early crushing unavoidable. A field attacked by locusts or devastated by wind and flood requires immediate harvesting to avoid total loss of the crop. However, the proportion of such cases is relatively small compared to those where further time might be allowed for the cane to mature.

A brief discussion of the changes taking place in sugar-cane juice during the process of ripening and subsequent maturity

[1] Press Bulletin No. 15 of the Bureau of Science, Manila, released May 30, 1913.

[2] Planters.

may not be out of place. The young stalks contain, besides cane sugar, a greater or less amount of dextrose and levulose. These sugars constitute what is called invert sugar and are responsible for most of the troubles experienced by sugar boilers. Their presence prevents the cane sugar, or sucrose, from crystallizing, and reduces the polarization of the resulting product. The juice from cane containing high percentages of these products shows a low purity upon analysis, and is not suitable for manufacturing purposes. Levulose disappears as the cane matures, and ripe stalks contain little or none of this sugar. Dextrose is a normal constituent of all cane, although present in gradually decreasing amount in ripening stalks. Sound ripe plants contain from 0.4 to 1.5 per cent of dextrose. Further growth after maturity results in causing an inversion of sucrose with the formation of more dextrose and levulose. There is, therefore, a definite period when sugar cane should be crushed to secure the highest purity juice and maximum profit from the sugar.

Many considerations, beside unavoidable natural exigencies, have led *hacenderos* in the Philippines to start crushing their cane before it has reached the optimum condition of perfect maturity. In many cases this is the result of insufficient milling or harvesting facilities. When it is impossible to handle an entire crop within the period between ripening and subsequent deterioration, it is customary to start crushing green cane, gradually working into mature fields, and completing the season with overripe material. In this manner at least a portion of the crop is obtained in mature condition, and with good judgment none of it need be excessively green or overripe. If it be impossible to increase the equipment, this is doubtless the lesser of two evils. It happens frequently that the object in view is completely defeated, and the entire crop is crushed before any part of it reaches maturity. In such an event the unfortunate planter cannot possibly realize the full benefit from his cane, although the resulting loss might have been avoided had he delayed crushing until the proper time. Chemical analysis could have predicted the failure, and information on the subject would have avoided the mistake. Errors of this type are frequent when the season is two or three months late, as was the case this year, and are not always caused by ignorance of the condition of the cane. The great importance of planting at the proper season is recognized by all *hacenderos*. For this reason they are unwilling to suspend crushing while

the cane matures, fearing that planting for the following year may thereby be unduly delayed. Furthermore, the labor question offers additional difficulties. It is not easy to hold men even during the milling season, and were operations suspended it would be necessary to pay full wages to insure sufficient assistance when crushing was resumed. Without definite information on the subject, the planter naturally fears that delays may prove not only expensive, but fatal to his future crop. Moreover, such a procedure would exceed the experience of the native *maestro,* or chief sugar boiler, who would be very certain of dire results.

All of these difficulties are more apparent than real. It is neither necessary to postpone planting because the cane is unripe at a season when custom has decreed that it should be crushed, nor is it essential that this green cane be harvested at once.

Long usage in the Philippines has resulted in planting merely the tops of harvested cane for points, although the nature of the plant is such that a much larger portion may be employed, and is so used in nearly all cane-producing countries. The stalk is naturally divided into joints, each containing a bud or eye capable of producing future canes. Each bud is surrounded by several rows of translucent spots that develop roots when the cane remains in contact with moist earth for some time. Thus, short pieces of stalk including these reproductive areas may be used as points. The lower portion of the cane is usually too dry for this purpose, but the upper two-thirds may be divided into about 10 sections. These pieces should be soaked a short time before being planted, and will then sprout readily. The plants used for points should be carefully chosen from the least mature cane, discarding dead and dry stalks. Fallow land is always available for receiving the points so obtained, and planting may proceed without interfering with the remainder of the maturing cane. This departure from the customary practice of harvesting and planting has not been commonly tried in the Islands, but where it has been followed the results have been most satisfactory. It possesses the great advantage of utilizing many of the laborers in cutting points, preparing land, and planting the crop for the ensuing year. Thus a delay in crushing will not necessitate idleness on the part of all the laborers, nor will it postpone planting beyond the proper season. This removes the two objections most frequently raised against postponing crushing until the cane has matured.

The benefits derived from following the above outlined scheme

may be very great, and in extreme cases would often turn an actual financial loss into a considerable profit. Five examples illustrating as many variations in handling a field of cane may serve to make our contentions more clear, and at the same time show the different returns resulting from crushing the cane at various times. The crop under discussion would amount to 2,000 tons of mature cane. The *hacendero* possessed an ordinary mill, capable of producing 100 piculs of sugar per day, and employed 125 laborers during the crushing season. Expenses have been calculated on the basis of ₱5.60 per ton of cane, or ₱3.50 per picul of sugar.

Case I.—The cane was thoroughly ripe and at its highest purity when crushed. No. 1 sugar polarizing above 89 was produced, and sold for ₱7 per picul. This represents a profit of ₱11,200, or the maximum amount possible under the conditions applying to all these examples.

Case II.—The cane was not mature, and consequently weighed about 5 per cent less, or 1,900 tons. The purity was only 76 as compared to 89 in the first case, and the extraction averaged only 6.[1] The entire crop was harvested before any portion matured, and consequently all the sugar obtained was "corriente," polarizing under 76 and selling for ₱2.50 per picul. The cost of harvesting and milling was practically the same as in the preceding case, but the result was a loss of ₱6,080.

Case III.—The cane was identical with that in the preceding case, but crushing was delayed for three weeks. The laborers remained idle during this time and received ₱1,050 in wages. The cane had not reached full maturity at the end of the three weeks, but showed a purity of 84 and weighed 1,950 tons. The extraction was 8.5, and the resulting sugar was No. 3, polarizing between 82 and 84.9. This sold for ₱5.50 per picul and netted a profit of ₱2,616.

Case IV.—The cane was identical with that in Case III, but was allowed to stand in the fields for six weeks instead of three. This resulted in a purity of 89 and extraction of 10. The cane was, therefore, fully ripe and comparable to that in Case I. The sugar produced was No. 1, polarizing above 87, and sold for ₱7 per picul. The profit of ₱9,100 is lower than that in Case I, due to ₱2,100 paid the laborers during the six weeks of idleness.

Case V.—Advantage was taken of the idle period for cutting

[1] Calculated from data given by Walker in "The Sugar Industry in the Island of Negros."

and planting. The result was a profit equal to that realized in Case IV, but with the very great added advantage that the crop for the ensuing year was planted at the correct season and under the best conditions for growth and development.

These cases are purely hypothetical, but are based upon laboratory experience and actual conditions frequently occurring in our sugar industry. The data from them are given in the following table:

Results of harvesting cane at different periods of maturity.

Case No.	Cane.			Sugar.				Receipts.	Expenditures.	Profit.	Loss.
	Tons.	Purity.	Extraction.	Tons.	Piculs.	Grade No.	Value per picul.				
1	2,000	89	10	200	3,200	1	₱7.00	₱22,400	₱11,200	₱11,200	
2	1,900	76	6	114	1,824	6	2.50	4,560	10,640	----------	₱6,080
3	1,950	84	8.5	165.8	2,652	3	5.50	14,586	10,920		
									[a] 1,050		
									11,970	2,616	
4	2,000	89	10	200	3,200	1	7.00	22,400	11,200		
									[a] 2,100		
									13,300	9,100	

[a] Labor.

The above data should convince planters of the intimate relationship existing between purity of juice and the success or failure of their undertaking. When they realize that the laboratories of the Bureau of Science are in a position to predict the grade of sugar which may be expected from a field of cane by a chemical analysis of carefully selected stalks, avoidable losses such as are illustrated in Case II will no longer be of common occurrence. It is not necessary to start crushing the cane to determine the purity of the juice. One-half dozen representative stalks from the field may be cut, carefully packed, and shipped to the Bureau of Science, either in Manila or in Iloilo. The sample should be packed in moist cloth whenever more than two days are required for transit. The quality of sugar that may be expected from cane corresponding to the samples may then be as accurately determined as if the mill had been started and a portion of the sugar actually produced. By having analyses of the cane made from time to time, the planter may follow the progress of development and start crushing with confidence in the final outcome.

AGRICULTURAL CONDITIONS IN THE SUBPROVINCE OF BENGUET.

By AUSTIN M. BURTON, *Agricultural Inspector.*

Benguet, a subprovince of the Mountain Province, is situated in the north-central part of Luzon and bounded on the north by Lepanto and Ifugao, on the east by Nueva Vizcaya, on the south by Pangasinan, and on the west by La Union Province. Benguet is probably best known as being the subprovince of which Baguio is the capital. The subprovince is largely mountainous in character, and as the elevation runs from near sea level to over 8,000 feet (2,438 meters) there is naturally a great variation in climate and natural vegetation. At an elevation of approximately 4,000 feet (1,219 meters) the pine belt commences. In the higher altitudes live oak and cedar are also found. The larger part of the tillable land is found in small valleys through the mountains. Some of the principal agricultural sections are Trinidad Valley, Pugo, Ambuklao, Kabayan, Tublay, Bokod, Bugias, Sablan, and Kabungan. The compiled reports of the different township secretaries show 9,795 hectares of tilled and 13,108 hectares of untilled land in the subprovince. Much of the land which cannot be tilled is utilized as range for live stock.

The climate of Benguet varies with the elevation, but taken as a whole is ideal. In Baguio, which represents a fair average for the subprovince, the days are seldom uncomfortably hot and the nights are cool enough to make the use of two or three blankets necessary. The best season is from November to March or April. From April to the end of June there are generally showers in the afternoons, although the mornings are bright and sunny. The rainy season usually extends from July to October, inclusive, and is characterized by heavy rainfall, although, even during these months, the mornings are often pleasant. The mean annual rainfall at Baguio is about 146 inches (3.71 meters).

The general agricultural conditions in the subprovince at the present time are decidedly favorable to good crops, as the last

rainy season was not severe, nor has there as yet been enough dry weather to seriously affect vegetation. The transplanting of rice has been going on now (February 15) for about six weeks, and if conditions continue as favorable as at present a good yield may be expected. Corn will not be planted, except where irrigation is available, until the first rains start, probably in April. Considerable tobacco has been planted in the township of Pugo, where the bulk of Benguet tobacco is grown.

Last year there was raised in Benguet 8,627 cavans [1] of rice, none of which was exported; 79,038 cavans of corn, measured on the cob; and 350,000 kilos of tobacco. There are no cigars or cigarettes manufactured in the subprovince. Besides these crops there was a considerable amount of camotes raised which were consumed locally; also quite a lot of vegetables and produce of the Temperate Zone. These vegetables have been introduced by the Bureau of Agriculture, and their popularity and adaptability to Benguet conditions is shown by the considerable number of home gardens maintained by the Filipinos. A large part of the produce marketed in Baguio comes from these gardens.

Cattle raising is quite an important industry. Last year's census showed 12,254, cattle, 1,760 horses, 2,360 hogs, and 5,620 carabaos. The stock is remarkably free from infectious or contagious diseases. The principal danger in stock raising is from the severe typhoons which come during the rainy season. Deaths among live stock in 1912 amounted to 819 by slaughter or by accidental falls and 1 carabao died of rinderpest.

The Benguet Igorot is an industrious and thrifty individual, and as much of the field work is done by the women as by the men. In rice planting and harvesting a whole community will work together, going from one man's field to another until the work is completed. At the present time it is rather difficult to obtain Igorot labor on account of the large number of people working on the railroad, but under ordinary conditions there is no difficulty in obtaining good laborers at an average wage of ₱0.50 per day.

The agricultural machinery is the same as that used in other parts of the Islands—the carabao plow and harrow for preparing the land and the lusong (mortar) and al-ó (pestle) for cleaning the palay. The general custom is to pound out the palay as needed, as the rice keeps better as palay than as cleaned rice.

Camotes are grown for the most part in small patches on

[1] 1 cavan equals 75 liters.

the hillsides where it is impossible to use animals. The sod is turned with a sharp stick for a spade, and all the subsequent work of planting, weeding, etc., is done by hand. Camotes form quite an important part of the diet of the Igorot and are their main support in times when the rice crop runs short. The American sweet-potato plants distributed from Trinidad garden are much appreciated by the Igorot, as they give a much larger crop of better quality than the native varieties and have, therefore, been planted quite extensively.

The Igorots are adepts in irrigation work and keep their rice paddies covered with several inches of water during the preparation, planting, and a large part of the growing seasons. The System in Trinidad Valley is a fair example of their work. In this system the water is diverted from the gorge of the Balili, commonly called the Trinidad River, and runs in a small earth and stone ditch along the Trinidad Road to the rice paddies in the valley. The paddies are so laid out that the water runs from one to the other, all of them being kept constantly covered. A continuation of this same ditch supplies water to Trinidad garden.

Baguio is the distributing center and market place for the subprovince. The two principal roads running into Baguio are the Benguet and Naguilian Roads. The Bureau of Public Works automobiles carry passengers and freight from Camp 1, where they connect with the Manila Railroad Company's train. Much produce from the lowlands is brought in over the Naguilian Road. Construction on the Manila Railroad Company's line to Baguio is being pushed along rapidly, and Baguio will have a railroad within a year or so. There are also a number of trails running into Baguio which lead to practically all parts of the Mountain Province. The subprovince has 125 kilometers of road constructed of which 56 kilometers are first class, 47 kilometers second class, and 22 kilometers third class. There are 354 kilometers of trail.

CURRENT NOTES—JULY.

NOTES By O. W. BARRETT, Chief, Division of Horticulture.

THE COCONUT'S GREATEST RIVAL.

Though in some respects the humble peanut is one of the very severest rivals of the Philippine coconut in the world's oil markets, it is quite likely that after all is said and done there is more loose oil waiting to be handled in West African "palm nuts" than in any other entity. From Sierra Leone to Angola and from the seacoast back for 200 to 500 miles the country is simply overrun with the oil palm, and practically all that is lacking to upset the price of copra and to demoralize the coconut industry is the construction or rather opening up of more ways of communication and transportation routes from the hinterland to the Gulf of Guinea coast.

Knowing this fact, and with their long experience in the business, the great British syndicate of Lever Brothers, Limited, has recently acquired a concession on the upper Congo which is said to embrace nearly 5 million hectares (12 million acres). Were such a vast area of a fairly good stand of the oil palm to be managed along modern lines, it alone would sooner or later affect the price of Philippine copra and would practically drive smoky tapahan copra (utilizable for soap as is palm oil) out of the world's market.

COCONUT IMPORTATION INTO THE UNITED STATES.

Copra is sent into the United States in largely increasing quantities; according to the Daily Consular and Trade Reports of the United States Department of Commerce, the 1912 (fiscal) importations reached some 32,000 tons against less than 19,000 tons in 1911, and only 7,000 tons in 1908. It must be remembered, however, that the United States still imports vast quantities of coconuts in the shell from tropical America; in the last fiscal year some 4 million pesos worth of fresh nuts were brought in, or double the amount of ten years ago.

Last year the Philippine Islands furnished about 70 per cent of the supply of copra for the United States.

AUSTRIAN COCONUT BUTTER.

According to the American consul at Carlsbad the present output of coconut butter in Austria is approximately 300 tons per day; a few years ago the output was only about 50 tons per day. Although the price of this excellent and popular butter has increased from about ₱365 to ₱520 per ton, the factories can scarcely keep up with the demand.

COCOSE.

The French product sold under this name, manufactured from copra (probably with the addition of small quantities of other substances), is said to be rapidly gaining in popularity, especially among Mohammedan countries. Being assured that this product contains no trace of hog fat nor beef tallow, both Mohammedan and Hindu peoples can use it as a butter.

It would seem, however, that for the peoples of tropical countries wherein all butters are with difficulty kept from melting, a good coconut cooking oil would be in greater demand than a high-priced tinned butter like "Cocose," which now retails in tins for a little less than ₱1 per kilo.

ANOTHER NEW FOOD OIL.

Still another rival to Philippine copra has entered the field. In Madagascar and in both eastern and western tropical Africa rather large numbers of the baobab tree are found. From the seeds of this huge tree is obtained a fine yellow oil of pleasant odor, and, so far as known, free from any injurious effects when used as a food. Baobab oil, like that of the coconut, solidifies in part at normal temperatures, the liquid portion being almost pure oleic and the solid part a mixture of stearic and palmitic acids. It is proposed to use the hard portion in the manufacture of artificial butters and margarines and to put the liquid portion on the market as an olive-oil substitute.

However, the coconut planters need feel but little anxiety over the discovery of this new source of vegetable oil, since the tree is nowhere very abundant, could hardly be cultivated, and in the opinion of the writer, who was familiar with one or two species in central Mozambique for several years, the prolificness of trees, even those having a trunk 4 meters in diameter, is remarkably low; and though the oil content of the seed may be as high as 40 per cent, the seed content of the fruit (about half the size of the Philippine papaya) is comparatively small.

SOYA OIL.

According to the Daily Consular and Trade Reports the new process for the extraction of oil from soya beans is now a success. This process employs gasoline as a solvent, and in this way the cake or residue, known in Germany as "schrot," is free from the dangerous purgative substances which have hitherto practically prohibited its use as a cattle feed. With the old method of crushing and pressing, the proteid substances in the raw bean (which are the base of the bean "cheeses" so commonly used as food throughout the Orient) caused much trouble through the sticking of the "cake" to the press cloths.

PEANUTS.

The world's oil hunger is so great and is increasing so fast that the output of India and West Africa begins to assume almost incredible proportions. The peanut, being a very easy crop for even the most ignorant natives to handle, and moreover one which is a fairly good food seed, and one which can be stored well, it follows that transportation and demand are about all that is required to render this crop a very severe rival to copra.

Furthermore, the peanut in out-of-the-way places like tropical Africa is frequently used as a barter commodity, thus proving its well-established status as a "staple." The writer remembers an interesting case of this kind: In the hinterland of the State of Quelimane on the north side of the Zambezi River the Loamo tribe, having no means of procuring salt in their own territory, are accustomed to send carriers every few months down to the tribes near the mouth of the Zambezi to trade for this necessity; the carriers are obliged to travel through the worst lion-infested country in the world for several days, sleeping, of course, without protection and fully expecting to lose one or two members of each camp every night, and carrying a load of some 25 kilos of shelled peanuts sewed into bark bags, to receive only one handful of dirty salt per load at the end of the journey. That is, the peanuts, being the only commodity available for barter, were sold at probably about one-twentieth of their actual value, although they were staple and standard. In the West African colonies, too, the price paid to the natives producing the raw product is excessively low, and, moreover, cheap "trade goods" instead of cash are used in most cases.

It is interesting to note that even after the great recent increase in the copra shipments to Europe the amount of peanuts

handled at the great oil port of Marseille is nearly twice that of copra. This ratio, however, does not hold true for English and German ports.

The Coromandel coast of India (the west side of the Bay of Bengal) is now shipping to Marseille something like 250,000 tons of peanuts per annum, which should yield in the presses about 125 million liters (say, a million barrels) of oil. Unfortunately, the careless methods of the India natives in preparing their raw product result in more than one-half of the oil being rancid and unfit for food. It is a deplorable fact that practically no peanuts are produced to-day, commercially speaking, in the Philippine Islands. Many thousand tons could be grown without interfering with the other crops, and this would give very much needed funds to a large number of "small planters" throughout the Archipelago.

CITRUS CULTURE IN THE UNITED STATES.

The present crop of oranges in Florida is said to be excellent and will, of course, command unusually high prices on account of the recent disastrous freeze in California. At present in Florida there is said to be about 200 million pesos invested in the citrus industry. The annual output is valued at something over 30 million pesos, and it is expected that this "tidy sum" will increase within a very few years to something like 100 million pesos per annum.

Before the recent terrible disaster to the citrus groves in southern California that State was producing 40 per cent of the world's commercial oranges and 75 per cent of the total orange crop of the United States. California, however, produces only one-half of the world's lemons, Italy supplying, of course, practically all of the remainder.

A NEW FRUIT EXTRACT.

From the Daily Consular and Trade Reports we learn that the Citrus Fruits Company, an American corporation of Boston, Mass., has established a factory in Palermo, Italy, for the manufacture of some new citrus-fruit products. It is reported that there has just been perfected a secret process which allows the manufacture of fruit essences in concentrated form; this will be of great use and, we believe, will soon become popular in confectionery as well as in soda-water flavors. The latter subject is of much greater importance than most people realize,

and when we can have an evaporated orange, lime, lemon, and mandarin fruit paste or jelly, uncontaminated by "preservatives," a great advance will have been made. Now, if it is possible to make a flavoring paste from citrus fruits in Italy, why can we not in the Philippines put up similar articles from the pineapple, the mango, the lanson, the goyabano, the ates, the guava, and, better than all the rest, perhaps, the many excellent distinct-flavored bananas and plantains?

NOTES By P. J. WESTER, Horticulturist.

THE LATEST THEORY OF SEX DETERMINATION.

The determination of sex is a riddle that for ages has puzzled the minds of men, and numerous are the theories that have been advanced in an attempt to explain what factors determine the sex in the progeny, only to as frequently be abandoned as untenable in the light of experimentation; and it has long seemed and has been asserted by many that sex determination was a mystery held in trust by nature and one that was forever to remain unraveled. It now would appear that while it has continued to occupy the minds of many biologists, the problem has in reality already been solved for some years. This remarkable discovery, if it is true, will unquestionably mark a new epoch in animal as well as plant breeding and even in eugenics. In 1878 Prof. Theophilus Ciesielski, of Lemberg, Austria, as a result of continued experimentation begun in 1871, propounded the startling theory given here below.

From his work with dioecious plants, Ciesielski found that barely matured pollen produced a great proportion of male plants, while if he used thoroughly ripened, or "stale," pollen in fertilizing the female flowers, the progeny were nearly always females.

The original investigations by Ciesielski were conducted on *Cannabis sativa* and *Spinacia oleracea.* It is not necessary to go into the particulars of the experimental work which led to the discovery in question.

Those who are interested in the subject should consult the original article, which was published first in Latin and was later translated into English, in which form it appeared in "International Clinics" (Vol. III, 22d series, 1912), with a preface by Dr. S. W. Carruthers.

The experimental work with the two plant species mentioned was concluded in 1898, after Ciesielski had proved to his satis-

faction that pollination with freshly shed pollen resulted in male plants while well-matured pollen produced female plants.

Having reached this result in plants, Ciesielski extended his investigations to animals, and tested his theory in numerous experiments with rabbits, dogs, horses, and cattle, an overwhelmingly large number of which served to verify the previous results. Finally, Ciesielski states that he has repeatedly recorded the application of the same law in the human species also.

To sum up: According to Ciesielski the sex of the progeny is governed by the age of the male reproductive cells at the time of fecundation, and that the law discovered by him applies to all living things, whether plants, animals, or man.

In plants this new theory will be of more or less academic interest, but in its relation to animals and man the result may be much more important and far-reaching—*if it endures the light of careful research.*

A NEW PRESERVE.

In connection with the article on roselle which appeared in the May, 1913, issue of the REVIEW our readers may be interested in knowing that before the end of the current year "roselle sauce" will be placed upon the market in large quantities for the first time.

The Luzon Pineapple Plantation Company, operating in Cabanatuan, Nueva Ecija, is the first concern to enter upon the manufacture of the new preserve upon a large scale. Organized in 1911, principally with the object of growing and canning pineapples, this company acquired 1,024 hectares of land in the locality mentioned, of which 40 hectares were brought under cultivation, and 16 hectares planted to pineapples last year. It is planned to plant 24 more hectares to pines during the present year. They now have under construction a canning factory with a capacity of 8,000 cases per month which will be ready for operation by September 1.

Last year the company grew roselle experimentally from seed supplied by the Bureau of Agriculture, and several of the leading officers of the firm were so favorably impressed by the possibilities of roselle that they decided to plant 8 hectares to this crop this year, the fruit of which will be manufactured into "roselle sauce." Such of our readers as may be interested in the handling of this new product should communicate with Mr. Leon C. Kellogg, manager, Luzon Pineapple Plantation Company, Cabanatuan, Nueva Ecija, P. I.

A TREATISE ON MANGO.

This is the name of a small but eminently practical little publication, written by Mr. P. C. De, and first published in 1897, a second revised edition, the one coming to our notice, having been issued in 1904.

The author touches lightly upon the history, botany, and geographical distribution of the mango, but discusses the practical features of mango cultivation exhaustively and lucidly from a modern orchardist's point of view that is refreshing when we consider the dearth of good literature on the subject. In fact, we suspect that even to-day, nine years after its issue, the author is greatly anticipating the Indian mango grower in his orchard management.

Two hundred thirty-nine mango varieties are enumerated, the majority of which are accompanied by more or less incomplete descriptions.

Altogether, the aforesaid publication (which may be obtained by addressing Mr. P. C. De, 28 Beadon Row, Calcutta, India, inclosing money for the equivalent of 1 rupee) is one of the very best ever issued on the subject, and one that an up-to-date mango grower can ill afford to be without.

THE RICE WATER WEEVIL IN THE UNITED STATES.

Frequently we are tempted to say that we have in the Philippines more than our just quota of insect pests and fungi that devour and devastate our crops. Still there are many evils, the absence of which we may note with satisfaction, for instance, the rice water weevil (*Lissorhoptrus simplex*), which is considered the most serious rice enemy in the southern United States. While in many places where it has appeared the injury to the rice is insignificant, a crop loss of 75 per cent resultant from this pest has been reported from some fields in Arkansas. In addition to rice as a food plant, the rice water weevil also feeds upon many indigenous species of wild rice, water lilies, bulrush, swale grass, spatterdock, etc., and this increases the difficulties of its control. The principal damage is caused by the larvæ which feed on the roots of the rice; some slight injury is done by the adults devouring the leaves. One generation of the insect in one season is the rule.

A "NEW" GUANO DEPOT.

One of the most recent countries to be exploited for guano is French Somaliland. The extensive guano deposits on the numerous small islands on the coast of the French and Italian possessions in the Red Sea have been known to exist for some time, but it is only recently that their excavation on any considerable scale has been begun. The guano is shipped to Europe through the port of Jibuti and is said to be of high quality.

PHILIPPINE MANGO EXPORTS.

To those countries where the annual fruit exports total millions of pesos, the Philippine export figure of ₱20,000 for mangos for the month of May does, of course, appear as an insignificant item; but it is large, nevertheless, when we consider that during the fiscal year ending June 30, 1911, the total fruit exports from the Philippines amounted to but ₱19,994, and that the average annual exports of mangos for the past few years have been only ₱6,000. It is one of the straws that indicate the advent of better days for fruit culture in the Philippines.

ERRATUM.

On page 252 of the May, 1913, English REVIEW, the second paragraph of the current note entitled "Olive-oil crop in the Mediterranean countries," by P. J. Wester, should have read as follows:

> The olive fly is related to the mango fruit-fly discussed by the writer in a previous issue of the REVIEW, and is also a relative of the Mediterranean fruit-fly, which has been so destructive to the orchard fruits in the region from which it takes its name, so destructive also in South Africa and Australia, and which, more recently, has become notorious through its invasion of Hawaii.

TEMPERATURE AND RAINFALL FOR AGRICULTURAL DISTRICTS IN THE PHILIPPINES.

By the DIRECTOR OF THE WEATHER BUREAU.

APRIL 1913.

[Temperature and total rainfall for twenty-four hours beginning at 6 a. m. each day.]

Date.	Abacá (Manila Hemp).				Sugar, Iloilo.		Rice, Tarlac.		Tobacco.			
	Albay.		Tacloban.						Aparri.		S. Fernando.	
	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.
	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.
1	27.7	0.3	27.9	-------	27.1	-------	29.6	-------	26.7	-------	28.8	-------
2	26.7	-------	27.1	-------	27.4	1	28.2	-------	26	-------	27.8	-------
3	27.6	18	26.9	0.5	26.6	-------	29.2	-------	25.7	-------	27.4	-------
4	26.7	.5	26.3	2.8	27	-------	28.2	-------	26.5	-------	28.3	-------
5	27.1	.5	26	.5	26.3	-------	27.5	-------	26.8	-------	28.6	-------
6	27.1	-------	24.9	8.3	26.6	-------	28.3	-------	26.8	-------	27.6	-------
7	27.9	-------	26.9	-------	27.9	.5	28.9	-------	26.7	-------	27	-------
8	27.2	-------	26.6	-------	27.4	-------	29.9	-------	26.8	-------	27.4	-------
9	27.9	.5	25.2	19.1	26.9	-------	29.8	-------	26.7	-------	28.2	-------
10	28.1	-------	25.9	.5	26	3.3	29	-------	26.6	-------	29	-------
11	27	5.5	24.7	72.9	27.4	-------	30.2	-------	26.6	-------	27.9	-------
12	26.1	31.5	26	34.6	27.1	39.7	28.6	-------	26.4	-------	28.2	-------
13	26.2	12.5	25.8	11.7	26.9	-------	29.6	-------	27.2	-------	28.8	-------
14	26.2	22.1	25.6	20.8	26.6	-------	30.5	52.8	27.6	-------	28.2	-------
15	25.4	25.2	26.5	4.3	25.2	11.1	28.2	44.4	27.2	-------	28.8	-------
16	26	.8	27.9	.5	26.7	17.5	28.8	11.4	27	-------	28	-------
17	28	-------	27.2	.8	26.8	8.6	27.4	-------	26.1	19.8	28.4	18.8
18	27.3	7.9	27.3	.5	26.6	-------	27.7	2.3	24.8	29.7	27.2	4.1
19	27.1	3.8	26.9	-------	28	-------	27.5	1.3	25.3	1.3	25.7	-------
20	28	-------	26.2	8.6	28.1	5.3	27.4	-------	26.5	.5	27.2	-------
21	28.4	1.8	27	1.8	27.9	-------	28.2	-------	26.9	-------	28.5	-------
22	28.2	3.3	27.4	-------	28.2	-------	28.3	-------	27.5	-------	28.8	-------
23	27.6	16.8	27.1	2.1	28	-------	27.9	-------	27.6	-------	28.8	-------
24	28.4	.5	27.6	2.3	28.1	-------	27.2	-------	27.4	-------	28.4	-------
25	28	5.1	27.4	1.3	28	-------	28.9	-------	27.5	-------	28.3	1
26	28.2	4	27.2	.3	28.2	.8	28.8	-------	27.2	-------	28.2	-------
27	28.1	3	26.8	10.1	28.2	1.3	29.2	-------	26.9	-------	28	-------
28	27.1	18.4	26.8	5.1	27.8	.5	29.4	-------	26.8	-------	27.5	-------
29	27.9	.3	27.4	.5	28.2	-------	28.9	-------	26.8	-------	27.8	-------
30	28.3	-------	27.2	7.3	28.1	-------	28.4	-------	27.3	-------	29.1	-------



Corral for the isolation of animals sick with rinderpest. Scout guard, Bureau inspector, and caretaker.

EDITORIAL.

THE PHILIPPINE VETERINARY PRACTICE ACT.

The regulation of the practice of veterinary medicine by legal restrictions limiting the treatment of diseases of domestic animals for pay to persons properly qualified by education is a matter of high humanitarian interest. Unqualified persons not merely fail to relieve suffering among animals, but by means of the brutal treatment inflicted frequently bring about worse injuries than the original diseased condition. The passage of Act No. 2245 by the Third Philippine Legislature, the text of which appears on page 362, is a matter of great importance. Its features compare favorably with the best of similar legislation elsewhere.

THE COLLEGE OF VETERINARY SCIENCE.

The popularity and success of the College of Veterinary Science, University of the Philippines, constitutes one of the brightest features of the progress of veterinary affairs in the Islands. Established three years ago with a curriculum of four years, the college was strengthened the next year by lengthening the course to one of five years of nine months each.

Happily, at the time of the foundation of the college there were men on the Board of Regents who appreciated the necessity for high and identical standards for veterinary and for medical education. Among them was Murray Bartlett, now president of the University of the Philippines, a fact that augurs well for the continuation of a policy of uplifting the veterinary profession by giving its recruits an education commensurate with the problems that it faces.

The Philippine Legislature has always displayed a liberal policy in dealing with educational matters, and the list of acts affecting the progress of the veterinary profession given by Drs. Palmer and Buencamino in their article on the college on page 368 embraces highly important legislation as affecting the future of the profession.

At present there are but two properly trained graduate Filipino veterinarians in the Islands, and to one of these, a joint author of the article in question, belongs the credit for conducting the clinic described in that article. During the first seven months of the existence of the clinic there were treated 510 cases of disease distributed among 457 animals. These figures for so short a period at the very inception of such a clinic are gratifying. They show a large amount of suffering among dumb animals relieved, and further give an indication of the need of Filipino veterinarians for general practice.

THE RINDERPEST CAMPAIGN DURING THE FISCAL YEAR ENDING JUNE 30, 1913.

The general policy of combating rinderpest by quarantine with the aid of the Philippine Scouts has been continued during the year. The progressive search of territory for rinderpest has involved work in Bulacan, Rizal, Laguna, Zambales, La Union, Ilocos Sur, and the subprovinces of Amburayan and Abra. Work of this character remains to be done in parts of Ilocos Sur, Abra, Ilocos Norte, Cagayan, and Isabela.

During the early part of the year the disease was apparently eradicated from the Provinces of Iloilo and Capiz. Minor outbreaks during the year were suppressed in Ambos Camarines, Antique, Bohol, Misamis, Leyte, Mountain Province, Surigao, and Tarlac.

Figures for the week ending June 28, 1913, show 6 provinces in which cases occurred; 8 provinces in which quarantine was in force, due to the discovery of cases within a month previous; and 23 municipalities known to be infected. Compared with the previous year this represents a gain of 3 provinces and 12 municipalities over the previous year. To this might be added 8 more provinces, not listed as infected at the beginning of the year, but in which rinderpest has been discovered and apparently suppressed during that period.

Of the 23 municipalities remaining infected at the end of the year, 11 are in Pampanga, 2 in Zambales, 1 in Pangasinan, 2 in La Union, 2 in Ilocos Norte, 3 in Cagayan, 1 in Isabela, and 1 in Ilocos Sur.

An encouraging feature is the apparent restriction of the area in which riderpest infection exists at present. During the year campaigns have been in progress in such widely separated islands as Mindanao, Leyte, Bohol, and Panay, besides the more extensive

operations on Luzon. At present writing known infection is restricted to the north of Manila Bay. Territory in which the campaign is being conducted at present, or which must be covered in the future, contains a large percentage of the carabao and cattle of the Archipelago. The combined figures for cattle and carabao in Zambales, Pampanga, La Union, Ilocos Sur, Ilocos Norte, Cagayan, and Isabela amount to 405,208. This is approximately 32 per cent of the number of cattle and carabaos reported in the Islands on July 1, 1912.

C. B. No. 16.

THIRD PHILIPPINE LEGISLATURE,
Special Session of 1913.

[No. 2245.]

An Act to regulate the practice of veterinary medicine and surgery in the Philippine Islands.

By authority of the United States, be it enacted by the Philippine Legislature, that:

SECTION 1. The following terms used in this Act shall, for the purposes thereof, each have the meaning and signification herein stated:

(*a*) The "board" shall be the veterinary examining board herein created.

(*b*) "Veterinary medicine" means the science and practice of healing, curing, treating, and killing any and all animals, whether by and with the use of medicines, drugs, or surgery, or in any other manner, for fees, pay, hire, or compensation; slaughtering animals for food shall not be comprehended in the term "killing" within the meaning of this Act.

(*c*) "Veterinarian" means every person authorized to practice veterinary medicine as above defined.

(*d*) "Diploma" includes every certificate, authorization, or other document issued by a school, as defined in the next following subsection, in which any person is declared or stated to be or to have been found to be qualified or competent to practice veterinary science or medicine.

(*e*) "School" includes every school, college, university, or other institution of learning legally qualified to teach veterinary science and the practice of veterinary medicine and vested with power and authority to grant or confer the degree of doctor of veterinary surgery or any like degree, or to issue diplomas conferring such degree, or permitting, licensing, or otherwise authorizing persons to practice veterinary medicine.

(*f*) "Certificate" means the document which the board is authorized in this Act to issue or has issued to any person, giving or granting to such person the right to practice veterinary medicine in the Philippine Islands.

(*g*) "Applicant" means every candidate for admission to practice veterinary medicine and every person who has made application to be examined by the board.

SEC. 2. The Governor-General shall appoint three reputable veterinarians to be members of and to compose a body to be known as the veterinary examining board. The persons so appointed shall be citizens of the United States or of the Philippine Islands and residents of the Philippine Islands and shall each have been granted a diploma by some reputable school of veterinary medicine and shall have practiced or taught veterinary science or medicine for not less than three years.

SEC. 3. The three persons first appointed under section two of this Act shall hold office, respectively, one for one year, one for two years, and one for three years, as the Governor-General shall designate; but thereafter the term of office of each member shall be three years or until his successor has been appointed and has qualified. Any member whose term has expired may be reappointed.

SEC. 4. Vacancies occurring on the board shall be filled under like conditions for the unexpired terms as those under which original appointments are made.

SEC. 5. Any and all members of the board may by the Governor-General be removed for misconduct, incapacity, neglect of duty, or other just and sufficient cause.

SEC. 6. Every person appointed as a member of the board shall, before entering upon the discharge of the duties of his office, take and subscribe an oath or affirmation for the faithful performance of his duties.

SEC. 7. That member of the board whose term of office may at any time be shortest shall be the president of the board. The board shall elect one of its members as secretary and treasurer. It shall provide a seal. It shall meet not less frequently than once in each year for the purpose of examining all applicants who may at such time be desirous of undergoing an examination. Of meetings held for this purpose the board shall give notice by publication or announcement in at least two papers published in Manila for not less than four weeks prior to the date of such meetings.

SEC. 8. The board may hold such other meetings and at such times as it may determine to be necessary for the proper conduct of its business and for the like purpose and to the like end may adopt rules and methods of procedure and assign duties to its members.

SEC. 9. The board is empowered to require oral and written examination from applicants, to prescribe reasonable rules and regulations for the conduct of such examinations, and to refuse to permit applicants to take or to continue examinations for any violation of such rules. The examinations shall be prepared and designed to test and establish the knowledge and qualifications of applicants of and with regard to the following and such further subjects as the board may deem advisable or desirable:

Comparative anatomy, physiology, chemistry, veterinary surgery, obstetrics, pathology, diagnosis, therapeutics, practice, and materia medica.

SEC. 10. The board shall prepare questions in each of the subjects named in the last preceding section and in such other subjects, if any, which may have been added thereto, and shall cause a sufficient number of papers bearing such questions, and all other necessary papers, to be printed or otherwise prepared so that each applicant may be supplied; and all written or printed questions at any examination shall be alike and uniform for all applicants taking such examination.

SEC. 11. Every applicant for an examination, and every applicant for a certificate to practice veterinary medicine, shall submit verified statements or such other proof as the board may require that he is a person of good moral character, that he has studied and duly passed examination in at least the subjects specified in section nine of this Act, or holds a certificate or diploma from some recognized and reputable school of veterinary science. No person who has been convicted by a competent court of a crime involving immoral or dishonorable conduct shall be permitted to take an examination or shall be given or granted a certificate to practice veterinary medicine. The board may refuse to examine or grant a certificate to practice veterinary medicine, or revoke a certificate already issued, for serious and justified reasons, in which case the interested person shall be so informed and what he has to say in his defense heard, and an appeal shall lie to the Governor-General.

SEC. 12. Every person of good moral character not less than twenty-one years of age who is a resident of the Philippine Islands, and who by verified statements satisfies the board to that effect, shall upon application be admitted to take examination with a view of becoming a certified veterinarian, but not until he has paid to the secretary-treasurer of the board the sum of twenty-five pesos as a fee for such examination. No such fee shall be returned to any person unless he decides before he has begun the examination to retire or withdraw therefrom.

SEC. 13. The board is authorized to issue or to refuse to issue to any applicant after examination a certificate to practice veterinary medicine, according as such applicant has been found to possess or to fail of the necessary knowledge and qualifications.

SEC. 14. The board is further empowered to issue without prior examination a certificate to any person over twenty-one years of age who has heretofore taken and passed a civil service examination as a veterinarian for service in the Government of the Philippine Islands.

SEC. 15. It shall be the duty of the board to cause to be prepared and kept a permanent record in which all persons to whom certificates have been issued shall be registered, and in which such other information as to the board may seem desirable shall be noted or recorded.

SEC. 16. The secretary-treasurer of the board shall keep minutes of the meetings of the board, shall be the custodian of the oaths of office of the members, and of the seal, records, books and other property of the board, and shall collect and pay into the Treasury all fees and moneys so received, and account therefor to the Insular Auditor.

SEC. 17. Every certificate issued under the provisions of this Act shall be regarded as conferring authority on the person to whom the same was issued to practice veterinary medicine in any province, city, or municipality in these Islands subject to the provisions of section eighteen hereof, and this authority and the conditions prescribed in the next succeeding section shall be set forth on the face of such certificate.

SEC. 18. Nothing in this Act contained requiring the payment of a fee for a certificate to practice veterinary medicine shall exempt any person who practices veterinary medicine from the payment of the internal revenue occupation tax of twenty pesos as fixed and prescribed in paragraph numbered ten of section one hundred and forty-four of Act Numbered Eleven hundred and eighty-nine, entitled "The Internal Revenue Law of Nineteen hundred and four." The Collector of Internal Revenue shall from time to time report to the secretary of the board the name and address of every person to whom an internal revenue tax receipt has been issued for the practice of veterinary medicine.

SEC. 19. Upon proof satisfactory to the board that any certificate issued by it under this Act has been lost or destroyed it may issue a duplicate certificate to the person to whom the first certificate was issued, after payment of a fee of five pesos for such duplicate.

SEC. 20. Nothing in this Act shall apply to veterinarians employed in the United States military service while they remain in the employ of the Government of the United States.

SEC. 21. The members of the veterinary examining board herein provided for shall receive a fee of five pesos each for each person examined for registration as a veterinarian.

SEC. 22. The Director of Agriculture is hereby authorized, subject to existing provisions of law, to furnish the necessary books, forms, supplies, and equipment for the proper conduct of the business of the board and to provide a place for its meetings and examinations.

SEC. 23. All persons falling within one of the following classes shall upon conviction be punished for each offense by a fine of not less than twenty-five nor more than one thousand pesos, or imprisonment of not less than one month nor more than two years, or by both such fine and imprisonment in the discretion of the court:

(*a*) Every person who, claiming to have been authorized and empowered to practice veterinary medicine under laws or regulations in force prior to the passage of this Act, shall practice or attempt to practice veterinary medicine or hold himself out to be a veterinarian after three months have elapsed from the date of the promulgation of this Act without having obtained a certificate from the board under section fourteen of this Act;

(*b*) Every other person who practices or attempts to practice veterinary medicine after the passage of this Act without having first obtained a certificate under section thirteen or fourteen of this Act;

(*c*) Every person practicing or attempting to practice veterinary medicine under a false or assumed name or holding himself out under a false or assumed name to be a veterinarian, and every person in any way falsely and fraudulently impersonating any veterinarian to whom a certificate has been issued;

(*d*) Every person who sells a certificate or diploma, every person who lends or permits another to have or use a certificate or diploma with a false or fraudulent purpose or intent, or knowing or having cause or reason to know or believe that such certificate is intended to be used for a false or fraudulent purpose;

(*e*) Every person who buys a certificate or diploma, or borrows the same with a false or fraudulent intent or purpose, or steals the same or acquires the same in any false, fraudulent, or unlawful manner;

(*f*) Every person who, with the intent to deceive the board, presents to the same as and for his own any diploma issued to another person;

(*g*) Every person who presents or exhibits to the board a forged or false diploma, or a diploma falsely or fraudulently obtained, knowing such diploma to be false or to have been obtained in a false or fraudulent manner, with the intent to deceive the board;

(*h*) Every person who presents or exhibits as a lawful certificate any forged or false certificate or any certificate obtained in a false or fraudulent manner, knowing the certificate to be false or to have been falsely or fraudulently obtained;

(*i*) Every person who knowingly practices veterinary medicine or attempts to do so, or holds himself out to be a veterinarian under cover of a false or forged certificate or of a certificate falsely or fraudulently obtained.

Enacted, February 11, 1913.

THE COLLEGE OF VETERINARY SCIENCE, UNIVERSITY OF THE PHILIPPINES.

By D. B. PALMER, D. V. M., and VICTOR BUENCAMINO, D. V. M., *University of the Philippines.*

The establishment of the College of Veterinary Science of the University of the Philippines is a direct result of the devastation wrought in the Philippine Islands by rinderpest and represents an effort to combat the disease by training men for the purpose. It is an interesting fact that the very first veterinary colleges in the world were established in Europe for the same purpose and that the desired results were accomplished. A reason for the establishment of the veterinary college of nearly as great importance was the fact that hitherto no facilities existed for the training of men for general veterinary practice.

The College of Veterinary Science derived its origin from the act founding the University of the Philippines which was passed June 18, 1908, in the special session of the First Philippine Legislature. The first session of the college began in June, 1910. To aid in the establishment of the college the Second Philippine Legislature, by Act No. 2040, established 20 scholarships for worthy Filipinos, and appropriated the sum of ₱3,500 to maintain the same for the first year. On January 27, 1912, it further appropriated the sum of ₱7,000 for the maintenance of 20 of these scholarships during the college year 1912–13. A further impetus to the study of veterinary science was given by the Third Philippine Legislature when Act No. 2245 was passed, which act provided for a board of veterinary examiners to control the granting of licenses to practice veterinary medicine and to safeguard the interests of such members of the veterinary profession as receive its license.

The aim of the college is to maintain the highest standards in every particular which will lead to turning out men with the highest educational equipment for the task confronting them. The aim is not to give a great number of students a poor training, but rather to give the very best to a few.

Admission is restricted to students who have graduated from

Philippine high schools that maintain a four-year course and who in addition are free from entrance conditions.

The curriculum of the college embraces work for five years of nine months each, leading to the degree of doctor of veterinary medicine. A portion of the instruction given in the first year of college might be classed as preparatory study, but allowing for this, the period of instruction exceeds that of a four-year course given elsewhere. These standards exceed those of most of the veterinary colleges of the United States and make the institution comparable in the features mentioned with only the very best of the American institutions. It is believed that only two veterinary colleges in the United States maintain even a four-year course.

The faculty consists of five veterinarians, three of whom devote full time to instruction. In this connection it should be observed that all the laboratory and general-science subjects are taught in the college of medicine and surgery, a division of the university which maintains exceedingly high standards. Instruction received there in such subjects as pathology, bacteriology, physiology, etc., is supplemented by work given by veterinarians.

At the present time the main buildings of the college are situated at Pandacan, one of the suburbs of Manila, and are in close proximity to the Pandacan quarantine station of the Bureau of Agriculture.

The clinic of the College of Veterinary Science is located between Rizal Avenue and Calle Tayuman, occupying a site adjoining the grounds of the San Lazaro Hospital. This place was formerly the immunizing station of the Bureau of Agriculture. Having been abandoned for this purpose, the Bureau of Agriculture has given the university the privilege of using the same for a veterinary hospital. The site was chosen because it is favorably located to draw clinical material from the north and central districts of the city of Manila, on account of the large pasture grounds near by, and, further, on account of the stables already available.

At present there is one building, two stories high. The upper floor is divided into three rooms, two for the use of student internes and one for an office and the storage of drugs. The lower floor is the entrance for patients and at the same time the room for surgical operations on small animals. There are on the grounds three long open sheds, with 40 stalls each, built for cattle. These are now being used for patients. In one of the spaces between two of the sheds there is a smaller shed with

a wooden operating table for cattle, which takes the place of a surgical room for large animals. There is also, in the extreme south end of the grounds, a screened shed used for contagious infectious diseases.

When the clinic was first opened there were very few cases received because of the prejudice due to a belief existing that an animal which entered the hospital was as good as dead, the same being invariably shot by the veterinarian in charge. This was due to the fact that cases of surra and glanders were taken there by veterinarians of the Bureau of Agriculture and killed. It was difficult to overcome this prejudice, but to-day it can be safely stated that this has been done.

The clinic, during the school year, is open in the afternoon from 1.30 to 4. The owners are given free consultation and the animals free treatment. A nominal fee for feed, sufficient to pay expenses only, has been charged in cases where animals have had to remain in the hospital. The policy of administering free drugs was deemed advisable at first to draw clients; however, the clinic is so well established now that there will be a very nominal charge for drugs.

The clinic has been conducted since November 14, 1912, and has proven highly popular. From the date mentioned till June 14, 1913, there were entered 510 cases of disease, distributed among 457 animals. The majority of cases treated were horses, followed in number by dogs, cattle, swine, carabao, sheep, goats, and fowls. The horses are mainly the property of public-rig owners and proprietors of livery stables. The cattle brought to the clinic have been for the most part for castration, there being considerable of this work done on cattle shipped to the provinces for draft purposes. The small-animal clinic has not been as large as might have been expected because a majority of cases have been refused for lack of adequate quarters.

Many of the animals presented are owned by poor people who would not otherwise have their animals treated, and thus the work has brought relief to many suffering dumb brutes.

During the third year of instruction there were 26 students registered and at the present time, immediately before the beginning of a new year, 21 applications from qualified candidates are on file in the office of the dean, which will assure a 50 per cent increase at least. This, in itself, will show the impetus that has been given veterinary education in the Philippines.

THE SURRA-CONVEYING FLY OF THE PHILIPPINES AND SOME FACTORS CONCERNED IN CONTROL MEASURES.

By M. Bruin Mitzmain,
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In a campaign for the eradication of surra it is imperative to locate the guilty insect carriers before preventive measures can be undertaken, for it has been shown in many tropical countries that when the sources and modes of conveyance of infection have been exactly determined, relatively simple and effective measures can be adopted. In this connection the finding of insect carriers in the rôle of intermediate hosts of the trypanosomes of surra, or the knowledge that a cyclical development of the organisms takes place in the body of the insect, are questions of importance. As has been indicated by Bagshawe, it appears that an epizoötic of surra may be started from an animal in the blood of which trypanosomes are scarce. If it were known that one species of insect alone is capable of becoming infected from such a host and that flies of this species transmit infection to other animals for a period of many weeks, such knowledge could not fail to lead to precision and hence economy in preventive methods.

In view of the importance of this matter, the writer has instituted a series of studies undertaken to incriminate or to exclude from future practical consideration the various species of bloodsucking insects that might be concerned in the transmission of surra. *Stomoxys calcitrans* Linn. was first studied with reference to the possibility of its being the agent in the transmission of surra by mechanical transmission and with reference to the possibility of a cyclical development of trypanosomes in this insect. The results published in detail elsewhere [1] were such that this fly may be regarded as practically a negative factor.

[1] Philippine Journal of Science, Sec. B (1912), Vol. VII, pp. 475–519, and Bull. No. 24, Bureau of Agriculture, Manila, P. I.

Experiments with *Tabanus striatus* Fabr. yielded positive results, and it is now for the first time announced that the common horsefly of these Islands is a carrier of surra. This was the result of recent experiments conducted at the veterinary research laboratory at Alabang, the details of which will be described in forthcoming publications.[1] Unlike all other experiments with horseflies in other countries, the material used was a series of flies bred under observation in the laboratory, thus excluding any possibility of previous contamination. The transmission of surra was effected by the direct mechanical method, thus simulating the conditions of interrupted feeding of horseflies in nature.

Recently, the breeding places of this fly have been located. Previously, a fruitless search in the vicinity of Alabang along the small rivers, tide-water canals, and rice paddies had been conducted through a period of six months. The shore of Laguna de Bay was finally investigated with the result that many larvæ and pupæ were unearthed which developed into the recognizable adult forms of *Tabanus striatus*. A chain of barrios extends along the lake from Taguig to Muntinlupa in Rizal Province, and similar relations exist in the Province of Laguna. The dwellers have made vegetable gardens on the water front which are in cultivation for only part of the year. During the rainy season from July to January these garden lots are submerged. Toward the end of this period the lake water has receded somewhat. Usually before January 15 plowing commences, carabaos being utilized for this purpose. Beginning March 1 crops are harvested and in some instances the ground is replanted. This continues throughout the dry season.

The carabaos used for plowing the gardens in January are fairly covered with bloodsucking flies. Tabanids are present in abundant numbers. The eggs of these flies are laid on driftwood and rubbish in the standing water, and when hatched the larvæ bury themselves in the wet sand. Their food is supplied by the countless minute crustacea of the lake shore, and principally by the larvæ of the Muscid flies which are laid in the carabao manure. Several instances have been noted of *Tabanus* larvæ being seen buried in the manure in quest of food.

Thousands of full-grown larvæ and pupæ of the *Tabanus* fly have been found buried to a depth of 4 to 6 inches (1.02 to 1.53 decimeters) in sandy soil in the environment described. These,

[1] Philippine Journal of Science, Sec. B (1913), Vol. VIII, and Bull. No. 28, Bureau of Agriculture, Manila, P. I.

when collected and transferred to vessels in the laboratory, began to develop into adult flies March 1, 1913. As late as April 15, 1913, a great number of full-grown larvæ have been collected from gardens along the lake shore, so that it may be stated with certainty that several broods of *Tabanus* present themselves and that these broods overlap one another. Since it has been ascertained that the developed larva requires three weeks to complete its transformations, the emergence of flies in abundance may be anticipated in the Provinces of Rizal and Laguna in the latter part of April and the middle of May.

This information regarding the breeding habits of *Tabanus striatus* suggests a future possible line of attack to be directed against the surra carrier. The possibility of eradicating the fly in the larval stage offers a new problem for consideration.

Records of the number of individuals of the suspected insect carriers infesting animals at various seasons of the year have been made at the veterinary research laboratory at Alabang. These records are of value in checking results obtained from experiments in insect transmission. Several instances are cited here to exemplify the importance of this study. The facts are gleaned from the records of two years' observations taken at Alabang. During this period weekly or biweekly counts were taken of flies collected from various hosts so that the initial appearance and the seasonal preponderance of biting flies were accurately noted. Likewise spontaneous cases of surra among the work animals were noted and an attempt made to trace their origin. Of course, any evidence obtained even under the most painstaking surveillance would be essentially circumstantial, and this should be borne in mind when the findings are judged.

In 1911, on December 27, three carabaos used at the veterinary research laboratory as draft animals were found positive for surra. Incidentally, these animals were immediately isolated and were destroyed a few weeks later. In attempting to trace the origin of the infection it was discovered that in an adjoining corral three experimental carabaos which had been inoculated with rinderpest blood had likewise contracted surra. It is assumed, since the rinderpest carabaos were recent additions and no other animals were found harboring the trypanosomes at this time, that the possible source of infection was found in the experimental carabaos. At any rate, the six carabaos were in the open and exposed to the same insect carriers. The fly records show a marked preponderance of horseflies (*Tabanus striatus*) for this time and the month preceding.

In January, 1912, under the same environment, surra appeared in a horse quartered in a shed near the veterinary research laboratory. This was also a spontaneous case. Unfortunately, the case was not recognized as surra until several days after the initial rise of temperature, and the source of infection was not ascertained. However, again referring to records of fly enumerations it was seen that during this period *Tabanus* was present in relatively large numbers among draft animals kept in the open corrals.

The experimental data compiled from the foregoing observations made under practically field conditions have an important bearing on the epidemiology of surra. Certain other possible carriers were present to assume a rôle in these two instances. Besides *Tabanus,* the biting flies present in numbers sufficient so that they could not be regarded as negligible factors were *Stomoxys, Lyperosia, Hippobosca,* mosquitoes, and midges. The stable fly, *Stomoxys calcitrans,* has been eliminated in a rather exhaustive set of experiments, so that for the present discussion it may be regarded as practically a negative factor. *Lyperosia* and *Hippobosca,* two genera of flies which have been investigated from the standpoint of mechanical transmission, may also be eliminated. Mosquitoes, which have been investigated more or less thoroughly in Africa and India, may likewise be eliminated for the present on account of the negative results which followed the experiments conducted here by the writer. Midges, the *Chrinomidæ,* which are often present among the draft animals of the Philippines in tremendous numbers, may be still held under suspicion, although workers in Africa and India have dismissed these insects from serious consideration relative to disease transmission.

Thus by the above process of rather hypothetical elimination additional evidence is adduced by which *Tabanus,* the horsefly, is incriminated. It has been ascertained that a species of the *Tabanidæ* in northern Africa is a carrier of trypanosomiasis very similar to that of surra. *Tabanus* has been proved experimentally to be one of the carriers of surra in India and in the Federated Malay States.

Until such time as the common species of bloodsucking insects may be eliminated as factors in the spread of surra the question of distribution of biting flies will influence the work of control. If definite information can be ascertained regarding the preponderance of certain species at every season for a given locality, the work of prophylaxis may be simplified. To be sure, this

applies more directly to regions where the specific insect carrier is suspected or known.

Under ideal conditions the seasonal counts should be obtained monthly from the principal infected foci, or at any rate from the three geographical divisions of the Archipelago. From the records gathered by trained observers, the appearance of suspicious flies could be made the working basis for control measures. In this manner, and in this manner alone, accurate knowledge could be procured regarding the coincidental appearance of surra outbreaks and suspected insect carriers. Alabang, Rizal, and possibly Manila, are the only two points concerning which the writer has accurate information of fly distribution.

Of extreme importance in connection with the spread of surra is the predilection of bloodsucking flies for particular hosts. Certain it is that if suspected flies are not attracted by the host infected, disease does not result. The attraction, for instance, may take the form of color, odor, and degree of temperature. In the matter of color, certain flies are attracted toward white, but most species are attracted by dark animals. In regard to horseflies, the carabao is unusually favored in infestation by these persistent pests. During the season when *Tabanus* is prevalent, in one instance 61 of these horseflies were collected in less than fifteen minutes from a carabao kept in an open corral in Manila.

The relation of temperature to parasitism is, in the opinion of the writer, of some economic importance, although thus far the matter is rather in the theoretical stage. It has been experimentally demonstrated by Howlett in India that mosquitoes are positively attracted by a temperature higher than the normal. This theory may be extended to the bloodsucking flies generally. Other things being equal, the mammalian parasites are attracted toward an animal of high temperature. It has been asserted in all seriousness by Grassi, the Italian expert on mosquitoes, that these insects are attracted to persons who talk a great deal.

Under field conditions it is often observed that an animal, through physical injuries, bruises, etc., has a slightly higher temperature than its fellows. If one observes closely, it will be found that the injured animal attracts more biting flies than normally, and the consequent inroads of surra may be due to this factor or to the lowered resistance of the animal.

In relation to parasitism on animals in general it appears that *Stomoxys calcitrans*, the stable fly, attacks all with equal avidity

if not interrupted in the attempt. It is easily recognized why sick animals are marked for their attacks. It has been observed and confirmed by several investigators that infected animals, particularly horses, are more susceptible to the attacks of *Stomoxys* than are healthy horses. During an outbreak of surra two years ago it was noticed in a Government corral that three horses among a large number of work animals contracted surra probably several days before the malady was diagnosed. The attention of the veterinarian in charge was not attracted primarily by the clinical symptoms but more particularly by the unusual number of biting flies present upon one of the sick animals. This latter did not attempt to dislodge the parasites, and the flies were permitted to feed until engorged. The three horses were examined for blood parasites and found positive for surra with numerous trypanosomes. In this instance there was an interesting correlation between the number of blood parasites and the preponderance of biting flies. One horse, which had attracted attention on account of the number of flies infesting it, was found to harbor the greatest number of blood parasites. Incidentally, when the three sick horses were isolated the epizoötic was immediately checked.

In the matter of the destruction of horseflies, insecticides have been used, but these have proved more or less unsatisfactory. Substances acting as repellents have had a more favorable application, but direct methods of destruction have proved unavailing. The most useful application of these measures has been exerted in relation to the aquatic habits of *Tabanus*. Professor Hine has employed petroleum for spraying on the surface of stagnant water over which *Tabanus* eggs are laid, so that the larvæ when they hatch must pass through a film of oil. This is supposed to be quite effective against the adult flies which visit the water for drinking purposes. The same investigator provides a most effective measure of reducing the number of *Tabanus* flies by gathering and destroying the eggs. He records the results of an hour's work in the collecting of 433 masses of eggs which aggregated an estimated total of 108,250 single eggs.

In the Philippines the only remedial measure that has been applied for this species is the destruction of the adult flies, which are found at times in swarms on rain trees. Here they may be either collected with a net or trapped with tree tanglefoot applied to the trunk and larger branches. The destruction of trees and brush and other favorable resting places for horseflies in the vicinity of animal sheds and corrals is an important consideration.

It is not sufficient that the infected animals be isolated, but it is essential also that they and the healthy stock be protected from attack by flies. The use of fly screening for surra animals would, to be sure, aside from immediate destruction, afford the ideal protection. This, of course, may be extended to insure protection of valuable stock, studhorses, etc., especially during such periods when dangerous flies prevail. If screening is found to be impracticable, a considerable protection can be obtained in the use of darkened sheds, in the use of animal sheds exposed to strong winds, and in sheds and corrals distant from bodies of water.

Animals at work or at pasture may be covered with a protective wash. Sores and skin abrasions of all sorts should be kept covered with tar or some other antiseptic greasy substance disagreeable to flies both of the bloodsucking and nonbiting species. The latter should not be ignored as factors in surra dissemination, for it has been proved that these flies act as passive parasites in drawing blood from wounds produced by the proboscides of *Stomoxys* and *Tabanus* and are capable of producing infection by mechanical means of contamination.

In general, the influence of a dark stable is quite marked in reducing the number of all species of flies which obtain access to draft animals. It is recommended that animal sheds be constructed with the roof as low as the height of the animals will permit. This can be done without interfering with the supply of fresh air. One research worker states that he found surra unable to spread among animals kept in a stable of this sort, but when they were tied immediately outside of the protection afforded by the low roof the animals contracted surra. In this stable, during one entire surra season in India, only two or three *Tabanus* flies were found on animals.

No excuse will be offered for assuming that all flies inhabiting stables and corrals are to be treated with suspicion in connection with control measures. Whether or not all of the bloodsucking flies have been proved to play a rôle, or whether or not the nonbiting flies are a practical factor in surra dissemination, a generous policy in suppressive measures should include all for reasons to be determined later. The presence of the house fly, representing the nonbiting flies, aside from the fact that it is an evidence of bad sanitation and doubtless a dangerous factor as regards several diseases, has been proved to be instrumental in the distribution of surra.

In the disposal of animal manure it is necessary to consider the breeding habits of the parasitic flies. It has been ascer-

tained that some species breed only in certain manures. The horn fly will not breed in horse manure, and the stable fly breeds rarely in carabao manure. Emphasis should be laid on the fact that the all-important *Tabanus striatus*, the horsefly, does not normally breed in manure, and when young forms of this fly are placed experimentally in great numbers in manure of various kinds the fly does not mature.

Concerning the disposition of fecal matter, it has been recommended that all offal should be burned immediately after the end of the rainy season. If this is not practicable, the accumulated manure should be sprayed with insecticides or treated by some other direct measure to insure the destruction of larvæ and pupæ. If these methods are not sufficient, they may be supplemented by natural enemies of the manural fauna, notably predaceous beetles and ants.

In relation to such parasites as the *Lyperosia* and *Stomoxys* flies, the standard means of control recommended may be applicable to the Philippines. Means are taken to prevent the abundance of the flies by the destruction of fly larvæ in the dung and the protection of the animals from attacks of the adult fly. The direct measures of destruction recommended as a partial means of reducing the number of adult insects are not always practicable and have little utility in the case of grazing animals on a large range.

Lime has been used effectively to destroy larvæ inhabiting the dung. This is advantageous in small pastures at the time of the year prior to the appearance of the first brood of flies. This is obviously a means of reduction of flies in the immediate vicinity of the animal sheds. Any means providing for the rapid dessication of the animal droppings are, to be sure, commendable, and this is effected in some localities by spreading fresh manure by various mechanical means, including the questionable practice of utilizing pigs for this purpose.

The use of repellents in the form of greasy substances has a limited application in mitigating the evil of fly infestation. A great many oils and fats have been experimented with, and insecticides acting more or less as temporary repellents have been discovered. The mixtures are usually applied with the addition of some antiseptic, to assist in healing if any sores are present. When applied in the dry season the wash must be renewed every two or three days. It may be unnecessary to attempt to protect the entire animal, but only those parts inaccessible to the head and tail of the fly-infested animal. The

following substances have been given a rather extensive application by the United States Bureau of Entomology: Fish oil alone, or mixed with sulphur and carbolic acid; kerosene emulsion alone, or tobacco water added; and in addition resin and oil of tar. For the control of flies infesting large herds of bovines the use of cattle-tick dipping vats with a suitable insecticide has been recommended. This has been applied with phenomenal results in parts of Texas.

Speaking of novel methods of fly destruction, the writer is tempted to refer to tests made, in modern times, of fly repellents by two quite distinguished German chemists. Seriously, since little else more practicable is offered, the principle involved may be after all a dependable solution. Tests were made concerning the action of potassium tellurate as a repellent for mosquitoes, flies, and ticks. The chemical was administered in the form of an insectifuge in the drinking water of nine horses and a cow. Ten grams were used for each animal in doses of 1 to 5 grams. Only negative results were obtained, the experimental animals continuing to be annoyed by flies. However, experiments with oleum lauri as an insectifuge are said to have given quite positive results.

OBSERVATIONS ON THE CLINICAL DIAGNOSIS OF GLANDERS.

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With the advancing knowledge of medicine, the subject of prophylaxis is steadily assuming a more important place, especially as related to infectious and epizoötic diseases. Diseases that are transmissible from animals to the human family have, during the last three decades, received special attention. If we can reduce the number of animals affected, and reduce the number of carriers of germs destructive to animals and man, we reduce the mortality among our population and limit economic losses.

In no other class of diseases is it so necessary to establish, at the earliest possible moment, a correct positive diagnosis as in outbreaks of epizoötic diseases.

Among this class of maladies, glanders has always been recognized as of the utmost importance, because it is fatal to man and because the economic losses to the community through death of horses are great.

In order to control an outbreak of glanders successfully, a positive identification of the disease affecting the living horse is necessary. At times easy, it is often very difficult to establish a diagnosis that will be supported by post-mortem examination.

Many different methods have been advanced by numerous investigators, not one of which, however, answers all phases or all conditions brought about by the contagion. Besides considering the history of the suspected animals and clinical appearance at the time, the veterinarian must be familiar with the different special methods that have, from time to time, been brought forward to detect obscure cases of glanders.

1. The consideration of the clinical symptoms, subjective and objective, as they present themselves upon a careful physical examination of the animal is most important and may decide the case. Since, whenever the clinical diagnosis is at fault,

a serious loss to the owner results, it must be supported by other special methods. Therefore we have to consider:

2. The excision of an enlarged gland and its microscopic examination.

3. The cultivation on suitable media of the organisms causing glanders derived preferably from excised tissue.

4. The inoculation of susceptible animals.

5. Auto-inoculation.

6. The subcutaneous injection of mallein.

7. The cuti reaction, now discarded.

8. The agglutination method.

9. The precipitation reaction as improved by Konew.

10. The complement fixation reaction.

11. Post-mortem examination whenever possible.

12. The ophthalmo reaction, or, if we are more careful and correct in our expression, the conjunctival reaction.

It is scarcely necessary to dwell upon the drawbacks of these special diagnostic methods. Veterinarians are all familiar with the limitations of the mallein test, as an example.

Considering the sero-diagnostic methods, we must say that they can be carried out only in properly equipped laboratories. During the early stages of the disease, the complement fixation test used by Mohler (1) often fails to give positive results. Whenever the animal has been infected ten days or more this test is, however, the very best method to detect glanders infection.

Among all these methods the busy clinician finds but one by which he can distinguish in a prompt and satisfactory manner animals that show obscure symptoms, or differentiate other diseases with symptoms similar to glanders.

About 1907 Vallée attempted to diagnose glanders in horses by the introduction of mallein into the conjunctival fold of the lower eyelid. He soon discarded the method as unreliable. Several investigators, however, were busy in devising methods suitable for clinical examinations.

Schürer (2) reported favorably on the conjunctival reaction as early as 1908, and its extensive use in the Austrian military service since then has demonstrated its value.

Fröhner (3) published a very complete report, covering observations upon 21 horses affected with glanders. The diagnosis of all these cases was verified by the introduction of 2 drops of a solution of 5 centigrams of dry mallein Foth dissolved in 4.5 cubic centimeters of 0.5 per cent solution of carbolic acid. After

twelve hours in positive cases a large quantity of purulent or muco-purulent discharge agglutinated the eyelids. Its production was continuous for twelve to thirty-six hours, more or less, in different cases. The discharge was pale yellow in color with a tendency to become viscid. The long hairs on the eyelids soon became matted together, especially near the inner canthus, and the discharge was often so profuse that it ran down over the cheek. The conjunctiva was markedly congested and sometimes the eyelids were swollen. The same amount of the same mallein solution applied into the lidsacs of healthy animals failed to produce any disturbance whatsoever. The reaction in these horses was typical, although the temperatures of the animals were high, between 38.5 and 39.5° C., which would prohibit the mallein test as usually applied. These 21 positive conjunctival reactions so carefully described by Fröhner were checked up with the complement fixation tests and the post-mortem reports, the results corresponding.

In 1911, Muller, Gächtgens and Aoki (4) published an interesting article on the relative value of sero-diagnostic methods and the conjunctival reaction as applied to glanders suspects among horses. From their observations they draw the conclusion that the introduction of a suitable mallein solution into the eye is the best and most practicable method to diagnose occult and doubtful cases of glanders.

In an exhaustive illustrated article Miesner (5) compares the results obtained with the complement fixation test, the agglutination tests, and the conjunctival reaction.

All these tests were executed with great care, the results are published in comprehensive tables, and they are substantiated by careful post-mortem reports.

One hundred and thirty-three glanders suspects were tested by the three different methods, and the results are compared and analyzed. As a diagnostic agent he used 3 centigrams of dry mallein Foth dissolved in 3 cubic centimeters of sterile normal salt solution. The solution was applied by means of a pipette or camel's-hair brush to the conjunctival fold of the lower eyelid. The reaction appeared in six to twelve hours and expressed itself in a pronounced discharge from the inner canthus which was muco-purulent, adhering to the lower lid, sometimes running down the cheek. In some cases a pronounced edematous swelling of both eyelids could be noted which produced a glassy appearance of the lids. Marked congestion of the conjunctiva and often complete agglutination of both lids were produced.



Photo by Dr. W. H. Boynton.

(*a*) Native pony, before introducing mallein solution into the eye.



Photo by Dr. W. H. Boynton.

(*b*) Same pony, eighteen hours after the application of three drops of concentrated mallein.

Typical positive conjunctival reaction.

After from fourteen to twenty-four hours the eyes began to clear up. Among 133 animals examined 59 glandered horses were diagnosed through the complement fixation test, an accuracy of 100 per cent. Fifty glandered horses were detected by the agglutination method, which number constituted 84 per cent of the cases detected by the complement fixation test. The conjunctival reaction detected 53 cases, or 90 per cent, of those shown by the complement fixation test. The complement fixation test did not condemn any healthy animals. The agglutination test condemned 2 horses, or 2.7 per cent of the healthy animals. The conjunctival test produced no reaction in sound horses.

The local application of a suitable mallein solution into the eye did not influence the sero-diagnostic methods.

From Java there is at hand a report of the work of Dr. L. de Bliek (6), director of the veterinary laboratory in Buitzenborg (Nederlandish India), who also indorses as simple and reliable the instillation of a solution of crude mallein into the eye. The conditions prevailing in this tropical region are similar to the Philippines and the animals affected show similarity in conformation and uses. The report considers every phase of diagnostic methods, compares the results of the agglutination and the complement fixation test, the subcutaneous injection of mallein, and the conjunctival test.

Results obtained with the last-named reaction were so satisfactory that De Bliek uses it in preference to older methods and hopes to eradicate the disease from the Island of Java by its systematic application.

Ten cases of strangles, 4 of saccharomyces, 5 of osteomalacia, and 1 of chronic catarrh of the sinuses did not react to the eye test.

Personal experience of the present writer, in four widely separated localities, has demonstrated the conjunctival reaction to be satisfactory and simple. During an investigation of an outbreak of contagious disease among native ponies at Calamba belonging to the Philippine Sugar Estates Development Company, its application gave negative results. *Streptococcus equi* was subsequently isolated from the afflicted animals, thus identifying the disease as strangles.

A glanders suspect was tested at the clinic of the College of Veterinary Science, University of the Philippines, and gave a positive reaction. The same animal was again tested at the veterinary research laboratory at Alabang. Its temperature was 39° before the subcutaneous injection of mallein and did not

rise during the following forty-eight hours. The swelling around the point of injection was 5 by 7 centimeters, hot and painful, and remained until the animal was destroyed. The application of 3 drops of concentrated mallein into the left eye produced after twelve hours a profuse pus-like discharge, pale yellow in color, which adhered to the hairs and to the inner canthus of the eye. The conjunctival membranes appeared inflamed and swollen; the pus flakes would at times cover the entire cornea. The condition is well illustrated in Plate II. Post-mortem examination showed changes characteristic of glanders in the lungs, liver, and on the nasal septum. *Bacterium mallei* was recovered from guinea pigs inoculated with pus from the submaxillary glands.

The same concentrated mallein was introduced into the eyes of five native ponies, selected at random, without, however, producing any changes. The mallein used in these tests was made from old cultures of *Bacterium mallei* at the veterinary research laboratory at Alabang.

In order to obtain a specific conjunctival reaction in animals affected with glanders, it is necessary that no irritating substances shall be present in the test fluid used, and that only a specific, intense mallein reaction be obtained. Five per cent sterilized aqueous solution of carbolic acid or preferably sterile normal salt solution are the solvents used to make up a 1 per cent solution of dry mallein Foth. It should be freshly prepared; 2 or 3 drops are applied to the conjunctival membranes of the lower lid. This may be done with a pipette or with a camel's-hair brush. A small hypodermic syringe with a short blunt needle is quite suitable.

The changes considered indicative of a positive reaction appear in six to twelve hours and usually begin to recede after twenty-four hours. If the reaction proves uncertain, the application should be repeated in the same eye in the same manner twenty-four hours after the first instillation. According to Miesner, this will show no increase if negative, or a marked increase if positive.

The test cannot be repeated afterwards, since the membranes of the eye become accustomed to it and fail to react in a typical manner for some time. The other eye can then be used.

The ease of application, the ready manner with which the necessary materials can be obtained and carried, the simple interpretation of the results, visible to the veterinarian and owner alike, the rapidity with which a great number of animals can

be passed upon, have at once recommended the conjunctival reaction to our profession. It produces a typical reaction even when the animals have high temperatures, as in the cases reported by Fröhner.

An important fact in its favor, so far as present reports are available, is that it does not condemn horses that are not affected with glanders. In addition, it is an easy matter to test the solution on healthy animals or to accept the nonreactors as checks.

The clinician who is often in trouble when he meets glanders suspects has, therefore, at his command a diagnostic method at once reasonably correct (90 to 94 per cent) and simple, and independent of the laboratory methods, something that will permit a vigorous fight along rational lines against one of our most dangerous diseases. It is of the utmost importance to be able to verify the physical examinations at once, and identify such a high per cent of occult cases without having to refer to distant laboratories.

Recently a disease resembling glanders has been reported in the Island of Catanduanes, and the authorities of the Province of Albay together with local horse owners have applied to the Bureau of Agriculture for assistance. The writer is at present engaged in field work on that island designed to control the disease. A comparison will be made of the accuracy of the various means for recognizing glanders, such as clinical diagnosis, the subcutaneous inoculation of mallein, the agglutination methods, the complement fixation reaction, and the ophthalmo reaction. All will be supplemented wherever possible by post-mortem examination, the results of which will set the standard with which to compare the accuracy of the various tests.

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RINDERPEST QUARANTINE IN LA UNION PROVINCE.

By JOHN D. REARDON, *Veterinarian.*

The topography of La Union Province is such as to present less difficulties in controlling the movement of animals than that of the provinces comprising the extensive central valley of Luzon. It occupies a long, rather narrow strip between the China Sea and the Gulf of Lingayen to the west and the Sierra de Ilocos on the east, is bounded on the south by Pangasinan, and on the north by Ilocos Sur. It is the southernmost of three provinces comprising the northwest coast of the Island of Luzon, all very similar in topography—the other two being Ilocos Sur and Ilocos Norte. All these provinces devote a great deal of attention to the breeding of carabaos, and annually send thousands of animals southward into the central valley.

The southern boundary of La Union, extending from Rabon on the coast to Camp One at the foot of the mountains, is only 12 kilometers in length. In the early part of 1912 a fence was constructed along this boundary in order to enable the Bureau of Agriculture to maintain an adequate check on all animals moving southward from the Ilocos coast.

This fence has five strands of barbed wire with posts 5 meters apart, the top wire 1.6 meters high. It is guarded by a force of 2 American and 12 Filipino inspectors. The fact that this fence has not been cut during the entire time that the Philippine Scouts have been employed on rinderpest eradication in La Union shows that the barrier on the south is sufficient. The seacoast along the boundary of La Union on the west is of such a nature that it is impossible for a vessel large enough to carry cattle to land at any point with the exception of Rabon, San Fernando, or Darigayos. Therefore the question of efficiently guarding the seacoast did not present much difficulty. The same is true of the roads and trails leading from La Union through the mountains on the east into Benguet Subprovince. The only trail that at all times is open is the Naguilian trail leading from Naguilian, La Union, to Baguio, Benguet, and there connecting

with the Baguio Road through Camp One into Pangasinan. Therefore, with the Naguilian trail guarded on the east, and the Pangasinan–La Union boundary fence on the south, together with a small guard on the seacoast, the probability of animals being able to pass from La Union, or the Ilocos Provinces to the north, into central Luzon are practically nil.

Scattered outbreaks of rinderpest have occurred along this coast for several years past. While the presence of the disease has not seriously crippled the animal-raising industry of these provinces, nevertheless it has been a constant menace to the central valley owing to the thousands of animals continually being sent to that section.

After the completion of the Pangasinan–Union fence, plans were made for a campaign of rinderpest eradication in the three coast provinces, to be carried on by the Bureau of Agriculture in conjunction with the Philippine Scouts. It was decided to start at the southern boundary of La Union and work northward, searching each municipality in succession and continually maintaining an east to west cordon.

On October 16, 1912, two companies of Philippine Scouts were detailed for duty in the Province of La Union. This force was augmented from time to time until at date of writing, February 1, 1913, six companies are on duty in the province. The Twenty-third Company commenced work in Santo Tomás, the southernmost town of La Union. They inspected northward through the towns of Santo Tomás, Rosario, Agoo, Tubao, Aringay, and Cava, taking in at the same time the adjoining townships in Benguet Subprovince which were situated east of La Union and west of the first high range of mountains. All of these municipalities were placed in quarantine for an observation period of fifteen consecutive days. All carabaos and cattle were tied up at least 20 meters apart with strong ropes not exceeding 1 meter in length. No work passes, or, in fact, movement of animals of any nature, were allowed during this fifteen-day tie-up. The usual sanitary measures were strictly enforced. All owners were obliged to provide each animal with food, water, and an individual drinking vessel. Thus, if any disease was subsequently discovered, the possibility of infection by direct contact or through utensils was avoided as much as possible.

No passes were given at any time for animals from other municipalities to pass on the road through municipalities in which the observation tie-up was in progress. Rinderpest was discovered in none of the municipalities lying south of Bauang.

The day that the Nineteenth Company, Philippine Scouts, was moved into Bauang, November 5, 1912, rinderpest was reported by the municipal president, and subsequent investigation by Bureau of Agriculture veterinarians showed four barrios infected with a total of 8 cases.

Three of the four barrios infected did not show cases after a period of ten days, but the fourth, namely, the central part of the town, continued to show new cases until December 15. It is considered that this was largely due to the fact that the central barrio covers a small area and contained so many animals that it was impossible to keep them the proper distances apart. Then, too, the center of the town was so thickly populated that there was considerable danger of indirect infection.

After the first ten days a night guard was placed on the central barrio to prevent any possibility of night pasturing.

The fact that the disease was not of a virulent type, the death rate being only 30 per cent, would also tend to show that there might have been some mild cases which escaped recognition.

From the time that the Thirty-fifth Company, Philippine Scouts, entered Naguilian, December 29, 1912, the movements of the Scout companies have been so arranged as to move northward in an unbroken line, thus preventing infection of the territory to the south which had already been inspected by the Bureau forces in conjunction with the Twenty-third Company, and had been declared as clean territory. Rinderpest was discovered in Naguilian, a municipality lying east of Bauang, on November 16, 1912. The disease in Naguilian was traced and showed that it had been brought in from Bauang.

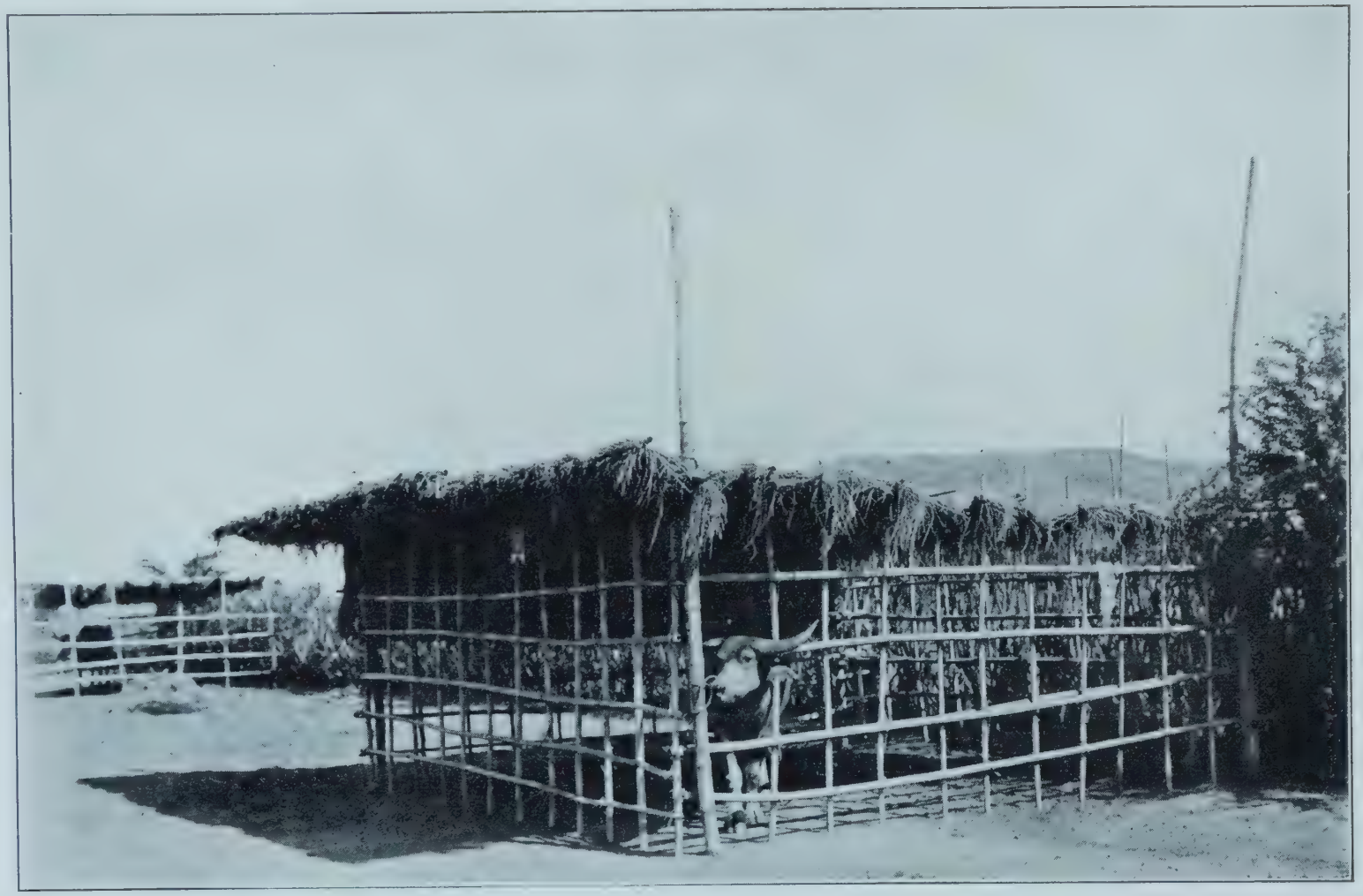
A small Bureau of Agriculture force succeeded in cleaning up Naguilian by the usual quarantine system employed in La Union, but with the very fortunate additional advantage of being ably assisted by intelligent municipal officials.

The president of Naguilian personally visited all infected barrios and barrios adjacent thereto, and explained the method of quarantine, and the necessity of coöperation by the people. He also stated that he would be obliged to deal severely with any persons found guilty of disregarding the quarantine regulations, explaining that such persons were a constant menace to the successful eradication of the disease.

The fact that no case was discovered in Naguilian after November 21 shows the effective results that can be obtained, providing the Bureau has the hearty coöperation of the officials and people at large.



Method of isolating individual animals exposed to rinderpest by tying under sheds.



Method of isolating individual animals exposed to rinderpest in closed corrals.



Outpost of Philippine Scouts on rinderpest quarantine duty.

All of the municipalities of La Union lying south of San Fernando have been thoroughly inspected and at the present time are free from rinderpest.

The first case of rinderpest occurred in San Juan October 19. This municipality has remained infected to the present date, but as only one case has appeared in the last twenty-five days, the prospects for the early eradication of the disease are encouraging.

The infection was so widely disseminated prior to the quarantine (and the disease was of such a mild type) that undoubtedly several cases escaped detection. This is considered the underlying reason for the continued appearance of isolated cases.

After the fifteen-day period of observation quarantine, the barrios in San Juan not actually infected were allowed liberty, but were subject to a triweekly inspection.

This method was found to be unsuccessful, as the people, thinking there was no quarantine outside of the infected barrios, did not always present their animals for inspection at the appointed time. Also, in order to avoid quarantine the people hid the infection.

In this way rinderpest was introduced into San Fernando on December 4, 1912. After this occurrence it was found necessary to enforce the stricter quarantine measures in force in the other infected districts in the province.

The last case in San Fernando occurred on January 14, 1913, and present indications are that the spread of the disease in this locality has been checked. Bacnotan is at present the only municipality in which cases of rinderpest are prevalent.

The following is the method employed in municipalities occupied by the Philippine Scouts where rinderpest is discovered: The entire municipality is considered infected and all animals are tied up 20 meters apart in all the barrios with the exception of the infected barrios and barrios lying contiguous thereto. No movement of animals for any purpose is allowed in the municipality for fifteen days. An isolation corral is constructed in the infected barrios in accordance with standard Bureau specifications. In addition to this a bamboo obstruction is constructed 50 meters distant from the isolation corral. A Scout guard is placed outside of this quarantine line whose duty it is to see that no one enters other than the caretaker or authorized agent of the Director of Agriculture.

All animals, in the infected barrios and adjoining barrios as well, are placed in individual corrals, 3 meters square, at least 40

meters apart, and wherever possible not less than 100 meters from a house. These individual corrals are constructed of bamboo or other suitable material and are not provided with gates. The owner is required to provide two short bamboo ladders in order that he may be able to climb over the fence and enter the corral to clean it. A depository 1 meter deep for the refuse is placed just outside of the corral, and a drinking vessel is placed in each corral. These individual corrals are provided with ample shade and are placed, whenever possible, in an open field. It is believed that a great deal of infection is carried because of the fact that all of the family and relatives of the owner of a sick or exposed carabao or beeve gather around the infected animal, and after examining it and placing their hands all over its body, return to their respective homes and examine their own animals to see if they are in the same condition. It has been observed that a large number of people will gather around the animal in this manner in places where ample natural shade is provided, but very few people care to go out into the open fields in the hot sunlight and discuss rinderpest. The construction of the individual corrals without gates is considered essential so as to prevent people from pasturing their animals at night.

Permits to work are given in the noninfected barrios after the completion of the fifteen-day tie-up and twelve days after the discovery of the last case in the infected barrios. When permits are given to work, the owner is obliged to construct an individual corral on the piece of land which he desires to cultivate and the animal is required to be in the corral at all times when not at work. No animals of the class affected are allowed to pasture until thirty days after the appearance of the last case of rinderpest; in other words, no pasture permits are given until the municipality in question is entirely released from quarantine. When enough Scouts are available, night guards are placed in the infected barrios.

A separate census is taken by the Bureau force and Scouts, which is checked over by the veterinarian with the commanding officer of the company. The following method is employed by the Bureau inspectors in taking the census: A list is made of the owners or caretakers and the number of animals that each owner has; this census is then checked with that taken by the Scout soldiers, and if any discrepancies are noted they are at once investigated, which precludes the possibility of either the soldiers or inspectors shirking their duty; with this preliminary census a Bureau inspector other than the one who took the first

census is required to list the animals in each barrio on the prescribed Bureau of Agriculture form. The point is, an accurate check of all animals should be obtained during the first five days of the quarantine so that an absolutely effective observation period of ten days may obtain.

The results obtained would seem to show that this method of quarantine is effective.

Since the 1st of January the rinderpest force and the provincial officials have worked in harmony. The provincial governor has sent letters of instruction to the presidents of the towns infected, and has addressed large meetings at the municipal buildings in the interest of the quarantine.

The work accomplished in La Union Province outside of the Scout force is not discussed here, as it was not in charge of the writer.

RINDERPEST IN THE AMBURAYAN RIVER VALLEY.

By C. H. Decker, *Veterinarian.*

The municipalities of Balaoan, Luna, and Bangar are situated in the Amburayan River Valley, the most fertile valley in the Province of La Union, which comprises approximately 100 square kilometers. There are between 8,000 and 9,000 carabaos in this district, and rinderpest has been very prevalent here for the last three years. During the early months of 1912 there occurred more than 300 cases and again in September, 1912, disease was reported in Balaoan and Luna.

At the beginning of this outbreak the work was rendered difficult, as the people, especially in Balaoan, were very much opposed to the measures adopted, entertaining the idea that they would rather have their animals die than undergo the quarantine. A great many animals were taken to the hills before the work was well organized, but a searching party of soldiers of the Philippine Constabulary and inspectors of the Bureau of Agriculture was formed later and sent through this section, bringing back all of the animals.

The whole country was flooded owing to the incessant heavy rains, making it impossible to use horses in inspecting the barrios. All the men were obliged to wade through mud and water in the performance of their duties.

Fifteen barrios in Balaoan and one in Luna were immediately found to be infected and about four weeks later disease was found in Bangar. Here it existed in 21 out of the 22 barrios, and also in 3 more barrios of Luna contiguous to Bangar.

On the first appearance of rinderpest in a barrio, the people were called together for the purpose of explaining to them the nature of the disease, the quarantine methods about to be used, and the necessity of pursuing such rigorous methods. At first the educational propaganda was not very much of a success, as all the Ilocano inspectors were inexperienced, the experienced men being the Tagalogs, who were unable to speak the dialect.

Animals were all tied in individual corrals, separated, whenever possible, by a distance of 20 meters. Mother and calf were

placed in the same corral which, whenever possible, was separated 40 meters from any of the others. In some cases it was very difficult to isolate the corrals on account of the inadequate space, as the fields were nearly all cultivated and inundated. Each animal was provided with an individual drinking vessel. A small can of disinfectant was placed at each corral and instructions given to the owner to disinfect his hands and feet every time he fed or went near his animals.

It was subsequently discovered that owners were taking their animals out of the corrals, and in order to prevent this all corrals were built without gates.

In the barrios where the disease persisted, night patrols and inspections were maintained, and in this way, although very difficult at times, the progress of the disease was checked. Also near all centers of infection in the barrios, all individual corrals were disinfected twice daily and only one person permitted to care for a group of animals.

When the quarantine force entered the municipalities all barrios were tied up and inspected daily for at least fifteen days and then if not infected the people were given work passes in their respective barrios, except in the case of barrios contiguous to others which were infected. In these, work passes were issued when it was thought there was absolutely no danger of spreading infection. In the infected barrios no passes were given until at least fifteen, and in most cases twenty, days had passed without the discovery of new cases. In all the barrios, both infected and noninfected, the owners were obliged to construct provisional corrals on the land to be cultivated and animals, while not working, were kept in these. Animals were not allowed to work at night in order to prevent any pasturing, which is generally the case when the people ask for work passes to be used at night.

Barrios would appear to be clean and then a case or two would break out again; in some barrios fifteen to twenty-five days elapsed between cases. This would make it seem as if animals were pasturing in infected barrios or going into other infected territory. However, all barrios were kept tied up until the end of the outbreak and animals were not permitted to pass from one clean barrio to another without a pass and also under guard, so as to prevent any danger of their going near infected territory or territory deemed to be dangerous. The fact is that the rinderpest in the Amburayan Valley was of a mild type, and it is the opinion of the writer that in barrios where long intervals occurred between clinical cases, animals had the disease in such

mild forms as to be unrecognizable, and the contagion was therefore spread to the other animals of a group by their caretaker. It is well known that caretakers are negligent in regard to disinfecting their hands and feet after tending to each individual animal unless they are constantly watched, and of course this is impossible without an exceptionally large force of guards.

In the municipality of Luna only four barrios were found infected, but all animals in the municipality were tied up and inspected daily for twenty-five days and all barrios contiguous to infected barrios and to Balaoan and Bangar were tied up till the end of the outbreak. This was done without any protests whatever from the inhabitants, as the officials were helping as much as possible, especially the president, and instead of the people complaining about the quarantine they coöperated in working to stamp out the disease.

In Tagudin and Suyo, which were later infected, restraint of animals in individual corrals was more satisfactorily accomplished and the barrios were more easily cleaned and kept clean on account of it being the dry season. Here in all infected barrios, animals were separated at least 30 meters, for all rice had been cut and it was possible to build the corrals in the fields.

The Constabulary soldiers were used mostly for night patrols and rendered good service all through the outbreak, although few in number. Sixty enlisted men and two officers were on duty.

The extent of the infection and number of cases and losses are shown in the following table:

Rinderpest statistics in the Amburayan River Valley.

Towns.	Barrios infected.	Cases of rinderpest.	Deaths.
Balaoan	15	60	30
Luna	4	13	9
Bangar	21	114	34
Suyo	1	9	3
Tagudin	7	73	30
Total	48	269	106

The death rate of those discovered to be infected was found to be 39.4 per cent.

KIDNEY-WORM INFESTATION OF SWINE.[1]

By William Hutchins Boynton,
Pathologist, Veterinary Research Laboratory, Alabang, Rizal.

Kidney-worm infestation may be regarded as an infectious disease of swine of which the specific cause is *Stephanurus dentatus*, a worm 30 to 40 millimeters in length. The parasites may be located in the fat surrounding the kidneys, in the ureters, encysted in the kidneys, liver, spleen, lymph glands, muscle, and connective tissue of both abdominal and chest cavities. The worms may also be found free or slightly embedded in the connective tissue of both cavities. The disease is characterized by muscular pains, tenderness to pressure over the kidneys, weakness, loss of appetite, emaciation, and partial or complete paralysis of the hind quarters.

From the reports at hand kidney-worm infestation appears to be more prevalent in the temperate and tropical climates than in the colder latitudes. It has been found in the United States, especially in the southern part. It is also present in South America, Australia, Asia, and the Philippine Islands.

The writer has had opportunity to observe the results of kidney-worm infestation in a herd of 20 thoroughbred pigs, the individuals of which were imported at various times from the State of Texas, United States, and from Australia.

The animals were maintained in the best sanitary conditions, being housed and kept on cement floors which were washed daily. The refuse was carried away through a sewer and never came in contact with the pigs. Each compartment had a small runway for the animals to get out on the ground. They were not crowded, for very seldom over 5 or 6 animals were kept in the same pen at one time. None but the boar came in contact with native pigs. Shortly before a sow was ready to give birth to pigs, she was placed in a pen alone, and kept there until the litter was old enough to wean. The only time during which a

[1] To appear in detailed form in the Philippine Journal of Science, Sec. B.

large number of pigs were together was after they were weaned. Those of nearly the same age were placed in a large pen by themselves. When they reached a certain age, the animals to be kept for breeding purposes were taken out and the rest were sold.

The first noticeable symptom is a stiffness of movement, as if the animal was suffering from muscular pains. This is especially perceptible in the hind limbs. As the disease progresses the animal becomes lame and weak in the loins. During this stage it lies down most of the time, and does not rise to its feet unless urged. In some cases, a few days before death, the animal loses partial or complete control of the hind quarters. There is tenderness over the kidneys, and the animal winces when pressure is applied to the back. Pigs usually eat fairly well up to within a few days of death, when they refuse food entirely. They generally become emaciated, but the reverse has been noticed in two cases where the animals were in good condition at the time of death. Dropsy was present in 3 of the 6 cases examined.

In the 6 animals examined, the worms were found both free upon, and inclosed in, the fat surrounding the kidney, in the ureters, in the pelvis of the kidney, and encysted in various parts of the kidney. They were found free in the abdominal cavity and often partially embedded in the connective tissue, not having as yet become encysted. They were found free on the surface of the liver, encysted in the connective tissue around the large blood vessels of that organ, and encysted inside of the liver, either in accumulations or singly. They were found embedded immediately under the surface of the liver and encysted in adjoining lymph glands.

In every case the liver was distended, soft, and of a dark purplish color. The borders of the lobes, instead of tapering down to a rather thin edge, were distended and rounding. In some instances collections of gas bubbles were noticed under the covering of the liver, suggesting that putrefaction was taking place rapidly. The dependent portions of the lobes of the liver were of a uniform dark purplish color and the individual lobules were not distinguishable through the capsule. The upper portion of the lobes had a mottled appearance. The majority of the lobules in some cases were of a dark-purple color, while the remaining lobules varied from a purplish tint to a gray-brown color. Upon section, the liver was soft, bulged out on the incised surface, and the borders of the lobules were indistinguishable. The lobes were adherent to each other by a gray, felt-like, fibrin-

ous deposit. This was especially prominent in the dependent portions. In three cases the liver was adherent to the diaphragm, breastbone, and stomach.

Several instances were noted where branches of the veins of the liver had been plugged up by deposits. The obstructions are undoubtedly the principal agents which cause the damming back of the blood in the liver.

The kidneys show as marked a deviation from the normal as does the liver. Sacs containing worms or decomposed worms are distributed throughout the organ. Scars may be observed on the surface of the kidneys in places where these cysts have been. In some cases the organ may for this reason exhibit a shrunken, uneven appearance, or the kidney may contain so many cavities as to roughly resemble a coarse sponge. Worms in sacs or changes due to their disintegration are likewise to be found in various lymphatic glands in the abdominal cavity.

Several writers state that the worm is never found in the interior of the kidney. This may be true in those cases noticed in the abattoirs where the infestation is not of long standing, but if one were to examine animals which have died of the disease he would find the kidney structure to be invaded in a majority of the cases.

Worms were found in great numbers encysted in the connective tissue along the back, especially in the neighborhood of the kidneys. In two cases the connective tissue along the spinal column extending from the tail to the diaphragm was a mass of cysts, most of them containing one or two worms and filled with purulent material. In three cases worms were found in the chest cavity, both free and embedded in the walls. One worm was found partly embedded in the lung tissue. They were also found embedded in the diaphragm. Thus it will be seen that when an animal dies of kidney-worm infestation, the disease takes on a generalized instead of a localized aspect, characteristic of earlier stages of the disease.

One of the most prominent changes to be noted at post-mortem examination is the rapidity with which the internal organs decompose. Four of the six animals were examined shortly after death, and upon autopsy the viscera had a pungent odor as if decomposition of the organs was well advanced.

Since the worms are encysted in the solid tissues and are surrounded by a purulent débris, treatment with vermicides introduced by the mouth is very unsatisfactory. Remedies could never be expected to reach the worms in sufficiently concen-

trated form to have any beneficial action. Hence, preventive measures are of more than usual importance.

Various investigators have come to the conclusion that the worm passes no part of its cycle of life in any other animal than the pig. Therefore every effort must be made to break the chains of succession in the reproduction of the worm by preventing uninfested animals from coming in contact with infested ones or with their excretions.

Law, in his Veterinary Medicine, states that "hogs should be excluded from all ground known to be infested, or on which infested hogs have been, or which receives drainage from fields, lots, or pens occupied by other hogs. * * * Above all, the pigs should be kept apart from slaughterhouses and streams into which they drain, and on no account should they be allowed the offal or flesh of other pigs, including scraps from the kitchen, until such material has been thoroughly cooked. * * * As in the case of other communicable diseases of pigs, the massing of these animals in large herds in contaminated localities is particularly dangerous. * * * Purchased pigs should be added to sound herds on the basis of irrefragable evidence of the soundness of the herds and the locality from which they came, and even then only after quarantine."

In Asia in certain localities this disease is very prevalent. The only way it can be controlled to any extent is by placing the pigs on slat floors, which allows the urine and feces to drain through. In this way the uninfested animals are not so apt to come in contact with the infective material.

A NOTE ON KIDNEY-WORM INFESTATION OF SWINE AS SHOWN POST-MORTEM AT THE MANILA MATADERO.

By R. W. Newcomb, *Veterinarian.*

The serious results caused in imported swine by *Stephanurus dentatus,* as reported by Dr. Boynton in his paper on this same subject, suggested an investigation of the prevalence of this parasite in native hogs killed at the Manila matadero. The conditions there permitted the gathering of information regarding the distribution of this parasite in the southern part of central Luzon.

At intervals of two weeks the writer has examined for the presence of these worms all of the swine slaughtered on a given day at the Manila matadero. In all about 2,000 hogs have been examined, and very nearly 50 per cent of all the swine slaughtered have been found infested.

Of these swine approximately 20 per cent were brought to Manila from the Province of Batangas, 20 per cent from Bulacan, 10 per cent from Cavite, 10 per cent from Rizal, 3 per cent from Zambales, and 1 per cent each from Tarlac, Pampanga, and Nueva Ecija. About 15 per cent were raised in Manila. The balance were from various districts. The origin of a few could not be traced.

The parasite is a round worm, varying from 30 to 40 millimeters in length, and pointed at both extremities. It is of a grayish-white color and more or less transparent, so that its spiral-shaped alimentary canal, which is black in color, is readily distinguishable.

The parasites are most commonly found in the fatty tissue posterior to the kidneys, though they may be found in the hilum of the kidney or even in the kidney tissue itself, and occasionally in the mesenteric fat, the psoas muscles, and the neck of the bladder. Tubular tracts are formed of hard connective tissue sometimes as large as a pencil, and having very thick walls. Often a sort of nest is formed, composed of many convolutions of a single tube or of several of the tracts combined. These nests

are often 2 or 3 inches (50 or 76 millimeters) in diameter. When found in the kidney tissue the parasites are usually very small. They cause destruction of portions of the kidney with a subsequent formation of scar tissue which upon contraction distorts the surface of the kidney to a marked degree, so that it is often possible to detect an infested kidney by its exterior appearance.

In chronic cases these tracts are often filled with a very dark brown serous fluid which is evidently a secretion of the parasite. Adhesions of the intestines to adjacent organs or other parts of the intestines are rarely found and very rarely an acute peritonitis due to perforation of the intestines or kidney.

However, out of 71,060 native swine examined at the Manila matadero during the past fiscal year, only four cases were found where the acute peritonitis was severe enough to warrant condemnation of the entire carcass, such is the apparent resistance of the native swine to the invasions of this parasite.

Pigs up to the age of 6 or 8 months are rarely found infested, and old breeding sows are rarely free from infestation.

It will readily be seen that owing to the location of these worms it is impossible to treat this condition with medicine, and it is equally evident that this parasite is bound to be a severe obstacle to the introduction of pure-blooded swine to these Islands.

A NOTE UPON STRANGLES IN THE PHILIPPINE ISLANDS.[1]

By WILLIAM HUTCHINS BOYNTON,
Pathologist, Veterinary Research Laboratory, Alabang, Rizal.

It is believed by some members of the medical profession that streptococcic infection in man is of rare occurrence in the Philippine Islands, and, when present, is mild in effect.

Since the diseases prevailing among the domesticated animals have not been worked out to any great extent here, it is not positively known whether or not they suffer from such infection.

The existence of strangles or distemper in horses appears to have attracted very little attention in the Philippines, and although it has been recognized several times by veterinarians, the diagnosis in such instances was based entirely upon clinical symptoms, the causative agent not having been isolated and identified.

In searching for official reports on strangles in the Bureau of Agriculture files, none could be found; but by personal inquiry the writer has been able to gain some data as to its prevalence.

During the months of February, March, and April, 1909, shortly after the arrival of some old Army mares for breeding purposes at the Alabang stock farm, there was an outbreak of strangles which killed several colts, and ran a severe course in many others. By the strenuous work of the men in charge the infection was cleaned up and has not appeared since.

There have been several outbreaks of this disease at the Trinidad stock farm during which several colts and older horses died. Veterinarians who have worked in Manila state that strangles is quite prevalent among the carromata horses, and also occurs frequently in the city stables. A few years ago this disease is said to have killed one of the finest race horses in the Philippine Islands.

Strangles appeared among the horses at the Singalong experiment station in Manila about March 10, 1911, and on March 26

[1] To appear in detailed form in the Philippine Journal of Science, Sec. B.

horses which apparently had not been affected by the disease during this outbreak were shipped from Singalong to Trinidad. About the 15th of April the disease was observed among the animals at the Trinidad stock farm, but as the disease first appeared in a pony belonging to an employee at the experiment station, it is thought quite probable that the infection was brought in by this pony, rather than by the horses from Manila.

On April 3, 1911, the animal husbandry division of the Bureau of Agriculture shipped 11 horses suffering with osteoporosis from the Trinidad stock farm to the veterinary research laboratory at Alabang. The animals were transported in stock cars, arriving at Alabang in apparently good condition, except for the deformities caused by osteoporosis. They were placed in a shed previously occupied by cattle immunized to rinderpest which were used in the production of antirinderpest serum. Each horse was tied in a separate stall, but could easily reach over into its neighbor's manger on either side.

Case 1.—April 10, 1911, the writer's attention was called to a horse 1 year old which had a slight purulent discharge from its left nostril, the left submaxillary gland being slightly enlarged. The animal was immediately separated from the rest and its manger thoroughly disinfected. On the 16th of April this animal died. Post-mortem examination revealed typical osteoporosis lesions, the right femur being completely fractured about 3 inches from its head, and practically all the bones of the body were more or less affected, which was undoubtedly the cause of death. At the time of death the discharge from the nostril had practically ceased, but the affected gland was somewhat enlarged. Neither culture nor smear preparation was made from the discharge or gland of this animal.

Case 2.—April 17, a horse 1 year old which stood in the stall adjoining No. 1 displayed a purulent discharge from both nostrils. The animal was immediately isolated and the stall and manger thoroughly disinfected. On the 19th the submaxillary glands were enormously enlarged. Four days later an abscess broke, discharging a thick yellowish pus, and on the 26th two more abscesses broke. The horse was placed on the operating table and two more abscesses were opened with aseptic precautions. From these cultures were made on agar-agar and in plain bouillon. Several smear preparations were made and, after staining, showed upon microscopic examination large numbers of cocci and a few short chains containing from three to four elements each. On the 28th the agar culture showed several colonies of *Micrococeus pyogenes aureus* and *albus*. Besides these there were a few small grayish colonies which, upon microscopic examination of hanging drop and stained smear preparations, proved to be streptococci. Long chains of streptococci were also found present in the bouillon culture but were mixed with numerous micrococci. Subcultures on agar and in bouillon were made from the small agar colonies. On April 29 the subcultures in both media revealed pure cultures of streptococci.

On May 1, 1 cubic centimeter of bouillon culture was injected subcutaneously into each of 2 rabbits and 2 guinea pigs, and 5 cubic centi-

meters subcutaneously into the neck of a horse 1 year of age. The rabbits and guinea pigs suffered no ill effects from the injection. The horse on the second day after injection showed a large swollen area around the point of inoculation which was very tender. On the fifth day the swelling was 14 centimeters in diameter. The lymphatic vessels extending from it were swollen, giving an identical picture of a typical, local mallein reaction in a glandered horse. On the eighth day the abscess thus formed broke and discharged a large amount of yellowish blood-stained pus, which, upon microscopic examination of stained smear preparation, revealed large numbers of streptococci in short chains.

At the time the abscess broke the horse ate very little and had a depressed appearance, lying down most of the time. In a couple of days it regained its appetite, the swelling gradually subsided, and complete healing took place in fifteen days. The neighboring lymphatic glands were observed frequently, but no sign of enlargement or tenderness could be detected.

From all appearances this inoculated horse had a mild attack of strangles, the infection remaining localized at the point of inoculation.

Case 3.—On April 25, a 2-year-old horse which had stood beside the second case was observed to have a slight discharge from both nostrils. It was immediately isolated and the premises thoroughly disinfected. In three days it had a marked discharge from both nostrils, and both submaxillary glands were considerably enlarged. After ten days' duration the discharge ceased and the glands gradually returned to normal size. A few short chains of streptococci were found on microscopic examination of the nasal discharge. In fourteen days this animal had the appearance of being completely recovered from the attack.

Case 4.—On May 3, a small black mare 1 year old which stood beside the third case was observed to have a discharge from the right nostril. The animal was immediately isolated and the premises thoroughly disinfected. The following day there was observed a discharge from both nostrils and the submaxillary glands were slightly enlarged. At the end of ten days the discharge from both nostrils had ceased, and the glands were practically normal in size. Recovery was apparently complete in fourteen days.

From the results derived from the cultures and from microscopic examinations of the purulent discharges, it is evident that streptococci infection exists in horses in the Philippine Islands. Since bouillon cultures had no effect on rabbits and guinea pigs when inoculated subcutaneously, and did have decided effect upon a horse, it proves quite conclusively that the organism isolated was *Streptococcus equi.* No white mice were on hand, so the virulence of the culture could not be tested on them.

From the information gained through inquiry and the foregoing observations it is concluded that strangles is a widespread disease among horses in the Islands, an interesting fact in view of the reputed rarity of streptococcic infections in man.

THE LONDON EXPOSITION OF RUBBER AND TROPICAL PRODUCTS.

By O. W. BARRETT, *Chief, Division of Horticulture.*

In June, 1914, there will be opened in London a tropical exposition, theoretically of a twofold nature, comprising the Fourth International Rubber and Allied Industries Exposition and one of International Cotton, Fibers, and Other Tropical Agriculture Products and Allied Industries. This exposition will be held in what is unquestionably the best possible place for such an affair of world-wide interest, and both the producers of raw products and the manufacturers and dealers in both raw and finished tropical staples will have a rare opportunity to meet and compare notes in the midst of probably the finest display of this class of the world's merchantable goods the public has ever seen.

His Majesty the King of England is patron of the combined expositions, and the organizing manager is A. Staines Manders, esq., who organized the very successful Third Rubber and Allied Industries Exhibition in New York in the summer of 1912. The president of the rubber exposition is Sir Henry A. Blake, the ex-governor of Ceylon, Bahamas, Newfoundland, Jamaica, Hongkong, etc. The president of the cotton, fibers, etc., exhibition is Prof. Wyndham Dunstan, director of the Imperial Institute and president of the International Association of Tropical Agriculture and Colonial Development.

At first it was intended that the two exhibitions should be kept more or less separate, but since there are a number of countries preëminent in the tropical commerce of the world that are, nevertheless, unimportant as producers of rubber, and since they could not be expected to relish this arrangement, the committee on exhibits has agreed to combine the two exhibitions; both will now be held in the Royal Agricultural Hall, which is said to be the most conveniently located building in London.

The exposition will open on Wednesday, June 24, and will close on Thursday, July 9. While a fortnight is apparently too short

a time for such a great undertaking, the amount of business which can and will be done in London in these few days is probably much greater than most residents of tropical countries not familiar with that city believe. Holding the exhibits open for only a fortnight reduces considerably the expense, and combining the two exhibitions is, moreover, a very pronounced economy.

Together with the double exposition there will be held simultaneously an international congress of tropical agriculture which will be attended by delegates from all parts of the world. There have been so many remarkable changes in the way of advancement in tropical agriculture during the last few years that this opportunity for experts in all branches of the profession to meet and discuss the dubious matters which are still to be settled will result in great good to the participating governments as well as to the scientists and planters themselves.

It is interesting to note that the management has decided to create a palms and palm-products section on account of the tremendous importance of the coconut and its rival the oil palm—not to mention nipa, burí, sago, and several of the India palms which are rapidly increasing in importance in commerce. It is expected that the cotton, fibers, and other tropical products will easily overshadow the rubber, though one of the prime objects of the exposition was the advancement of the rubber industry. When we realize, however, that the fibers are really of much more importance to the general public, to say nothing of the vast commerce (hundreds of millions of pesos) in tropical oils, sugar, goods, etc., the Philippine Islands, like India, must logically rejoice in the prominence of the nonrubber side of the double exposition.

The available space for the exposition covers an area of 18,580 square meters (200,000 square feet). The space rate is necessarily rather high—about ₱20 per square meter (4s. per square foot). Exhibits should be installed early in June—which means that the Philippine materials should leave Manila by the middle of April, 1914. It is hoped that the best exhibit of Philippine fibers, palm products, tobacco, sugar, grains, etc., ever shown can be gotten together by that time. While it is not advisable to show materials in such large quantities as will be required at the Panama exposition at San Francisco in 1915, a display of every commercial Philippine product, carefully arranged and classified, should be in evidence. It is necessary to economize

space as much as possible, and with this end in view a large collection of photographs (many enlarged and colored) illustrating every phase of agriculture in the Archipelago, together with a set of natural-size water-color sketches of all Philippine fruits and vegetables, will be exhibited; the latter will attract the eye of the visitor, and both will be remembered even after the samples themselves, perhaps, are forgotten.

CURRENT NOTES—AUGUST.

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

ZOÖTECHNY AND COCONUTS.

In a recent number of Tropical Life, animal breeding on large coconut estates is advised. It is pointed out that in large estates, even if somewhat removed from good transportation routes, the coconut planter can very readily increase his income by turning his attention to this frequently very profitable branch of agriculture. The Bureau of Agriculture, also, recommended this policy in Bulletin No. 25, "The Philippine Coconut Industry."

In Ceylon, for instance, the matter is being given the best attention, and it is expected that not only horses but also cattle, pigs, sheep, and goats will soon be very much in evidence on the better-kept coconut plantations of the Malay States, the East Indies, and, let us hope, the Philippines. The matter of feeding large numbers of animals is, of course, a difficult question; but considering the fact that all modern coconut estates will have their own copra dryers and oil presses, the cake from the oil machines must needs be used locally. Maize leaves, stripped at the time of harvesting the ears, make very superior "roughage," and if properly handled a good part of the maize stalks can also be utilized. Most cover crops, such as cowpeas, peanuts, etc., can, of course, be used for forage.

DEODORIZED OILS.

We have some splendid new theories to help us out with the exasperating mysteries of osphresiology, but thus far we do not know much about the sense of smell; in fact, it now seems there may be several distinct ways of "sensing" an odor. In certain lines of commerce, such as the marketing of oil from rotten or smoked copra, rancid peanuts, and fermented cotton seed, the good "bouquet" or bad "taint" of the finished product is, in the opinion of the consuming public, a pretty serious matter.

The new superheated-steam method of blowing bad odors out of impure or olfactorily objectionable oils is due to revolutionize the trade. There is a question whether it will be possible to blow out all the creosote smell from the tapahan copra oil of the

Philippine Islands; but even if it does succeed it will, we hope, not materially lengthen the period of apparent popularity of this execrable product. Good nutty or fruity smelling oils will always be far ahead of the nonodorous or deodorized ones, for obvious reasons. For instance, the sardine canner will look with considerable suspicion upon an oil supposed to be made from olives which does not carry the characteristic fruit-like smell and taste of the genuine article.

The salient fact connected with this new deodorization method is that it gives the low-grade and impure cheap oils a better chance to compete with the ordinary product, and while it may be practically impossible to implant, as it were, a good natural odor into the "blowed-out" oils, it must be admitted that no odor in a food oil is much more to be desired than a foul one.

KAPOK PRICES.

We learn that in March over 20,000 bales of kapok were burned at Samarang, Java. This heavy loss, coupled with the 14,000 bales burned about the first of the year at Surabaya, Java, will, it is expected, considerably affect the price of that fiber.

The United States imported in the fiscal year 1912 some 2,000 tons of kapok fiber, mostly from Java. This material, which seems to be rather rapidly increasing in value, is now worth over ₱600 per ton.

ANOTHER NEW PAPER.

Economists have for some years been busy with the sudd problem of Upper Egypt. The vast papyrus-covered areas of the swampy region of the Nile contain billions of tons of vegetable fiber which, when properly handled, can be utilized for either fuel or paper pulp. This sudd is a sort of spongy peat and when properly bleached, ground, and pressed can very probably be turned to good account in helping to relieve the excessive demand on the timber forests. Recent experiments in England have gone so far as to leave only a little doubt as to the commercial success of this venture.

A NEW CULTIVATOR.

From La Vie Agricole we learn of a new "automobile" cultivator. This machine, propelled by a small, light (2 to 4 horsepower) gasoline motor, is merely steered by the laborer who walks behind it. Any variety of attachments, such as hoes, shovels, harrow teeth, etc., may be attached to the base of the frame. This handy machine is mounted on three wheels, two

of which are connected with the motor. According to the particular model, the width of the strip cultivated is from 60 to 110 centimeters. We hope this apparatus will solve many of the orchardists' and horticulturists' difficulties in the way of rapidly and cheaply weeding and "dust mulching" fruit trees, gardens, and small plantations.

PINEAPPLES.

The public is apparently becoming almost ravenous for pineapples, fresh and canned. The growing importance of the industry in the Philippines is a pleasing feature of our new agriculture. The large plantation near Cabanatuan, Nueva Ecija, is reported as particularly promising, and the cannery will soon be ready for business.

The present outlook for a big crop in Cuba is good; considerably over one million crates will be turned out, mostly for the United States trade.

Unfortunately, Hawaii is prohibited from exporting fresh fruit to the United States on account of the terrible fruit-fly pest, but the canned article will, of course, go forward unhindered.

MAIZE SUGAR.

For the past three or four years sugar agronomists have had considerable worry, not to say trouble, over the possibility of the "common or garden variety" of maize rivaling cane in the sugar market. The United States was one of the first countries to investigate this matter and apparently the first to turn it down. However, now that India and Rhodesia (south-central Africa) have revived the interest in this very important subject, it behooves even the Philippine planter to experiment along this line.

The secret of the matter is, of course, known to the whole world, and there can never be any patent process in it except in some minor detail of the methods of extraction. The fact is, according to all records of experiments at hand, the maize plant when deprived of the ears at about the time starch is being deposited in the kernels, i. e., when the seed is "in the milk," does develop a remarkable saccharose, or, rather, glucose, content. Sugar cane is considered above the average if it analyzes 13 per cent of sucrose; it appears that the agricultural chemist of the Rhodesian Government finds as high as 12½ to 14 per cent of sugar and about 1 per cent of glucose in the decobbed maize stalks in his experiments; some of the Indian experiments at Pusa indicate that as high as 9 per cent of the weight of the maize stem may be turned into sucrose by the artificial upsetting

of the normal physiological function of this crop, which some experts believe will be, through its wonderful variability under the hybridizer's hands and its adaptation to man's varied needs, the greatest crop of the future.

SOUTH AFRICAN LOCUSTS.

Locust swarms continue to be a very severe plague in the greater part of the Union of South Africa. A government locust bureau is maintained there and it seems to be kept exceedingly busy. Instead of the "pit method," which is almost absolutely necessary in a thickly settled country like most of the districts of the Philippines, where domestic animals are usually very much in evidence and frequently roam at large, the South African locust bureau depends entirely upon arsenical sprays for the destruction of the hoppers. This arsenate of soda stock solution is prepared by the government experts and distributed to the centers of infestation as occasion requires. In some districts the shortage of water is a very serious drawback, considering the fact that it takes from 50 to 65 parts of water to dilute the locust poison.

Sometimes, but rarely, it is possible to dig up the eggs if the swarm has oviposited in a level cultivated sandy area. A case in point occurred (during the writer's administration as Director of Agriculture for Mozambique) in the Zambesi district in 1909: Some 17 tons of migratory locust eggs were dug up by cheap native labor (mostly women and children) within the space of some 100 hectares on a sugar plantation in about two weeks' time—this constituting what will probably long remain the world's record for locust-egg destruction by hand.

SUNFLOWER SEEDS.

Recent trials at the Singalong and Lamao experiment stations indicate that several varieties of sunflowers grow fairly well here. One head weighing 1.7 kilos has just been harvested at Singalong.

Sunflower seed is now quoted at about ₱0.13 per kilo in England. There is also an increasing demand for the "cake" from the oil press. This seed stands long-distance shipping well. The oil content is about 32 per cent, or just one-half that of copra.

AMERICAN TRADE.

American merchants and commercial companies have been for many years criticised pretty severely for having made so little progress, comparatively speaking, toward getting the bulk or at

least the cream of the South American and oriental trade. The Panama Canal is supposed to be able to remedy some of the backwardness, if it is such, of American commerce. However, we must never lose sight of the following very important yet not generally appreciated fact: The home trade of the United States of America is something like ten times as great as the combined foreign trade of all the nations of the world put together. Logically, then, it is little wonder that American commerce can find no time to bother particularly with such a rather troublesome long-distance trade as that of the Philippines and the South American continent.

WHALE MEAT.

The popularity of whale flesh in Japan is steadily increasing. For several years past this meat has been used both fresh and canned very extensively in that country, and there are now in active commission a considerable number of whaling steamers hunting in the waters of Korea and southern Japan, the Oriental Whaling Company having 12 "whalers" constantly engaged. Over 100 whales were killed during last December in the Chosen Seas.

According to quality, the flesh is worth from ₱0.20 to ₱0.30 per kilo. Setting aside an unreasonable prejudice, there is only one good reason why we should not use the excellent-appearing meat of this wholesome warm-blooded animal (whose ancestors in the geological epochs are believed by some zoölogists to have been related to the cattle and swine of to-day), which is that in spite of the fact that the muscle substance is practically free from the fat and blubber blanket, it has a decidedly strong fishy taste and odor.

Recently, whale hunting has been very successful in the neighborhood of the Fiji Islands, and numbers of whalers are bound thither lured by the great profits of the trade.

TEMPERATURE AND RAINFALL FOR AGRICULTURAL DISTRICTS IN THE PHILIPPINES.

By the DIRECTOR OF THE WEATHER BUREAU.

MAY, 1913.

[Temperature and total rainfall for 24 hours beginning at 6 a. m. each day.]

Date.	Abaca (Manila hemp).				Sugar, Iloilo.		Rice, Tarlac.		Tobacco.			
	Albay.		Tacloban.						Aparri.		San Fernando.	
	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.
	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.
1	27.9		27.3	2.3	27.8		30.4		27.2		27.3	
2	27.7	49.3	26.2	10.9	27.5		30.3		27.3		28.7	
3	25.7	28.2	25.3	30.7	25.8	6.1	30.4		26.8		28.2	
4	27.8	43.5	25.8	72.7	27.9		30		27.2		28.5	
5	25.8	97.8	24.9	143.4	27.6	2.8	30.4		27.3		27.1	
6	26	14.5	27.3	2	25.2	78.4	27.4	4.1	26.6	5.4	28	
7	27	.8	27.1	1.5	26.1		27.5	1.8	25.8	5.1	27.4	8.1
8	27.4		27.6	.5	27.4		26.2	24.1	27.9		24.4	5.4
9	28		28.1		27.5	1	27.2	10.5	25	131.4	24	35
10	27.8		28.2		28	2.8	27	8.1	26.2	1.3	25.6	22.1
11	28.4		28.5		28.2		27.8		27.4		26.3	24.4
12	28.3		28.3		28.4		28		26.9	3.8	28.2	
13	28.6		28		28.6		29.6		27.8		28.8	
14	28.8		28.4		28.4	3	29.3		28.4		26.8	
15	28.5		28.3	4.3	28.1		29.6		28.3		27.6	
16	28.8		28.3		27.8		29	22.1	27.6		27.4	9.1
17	28.4		28		28.1		29	20.3	27.2	9.2	26.4	
18	28.8	1	28.1	29.7	28.3		29	5.1	26.8	3	26.8	
19	28.2	25.1	27		25.8	1	28.8		27.2	16	27.6	
20	28	1	27	8.4	28.4		28.4		26.7		27.4	
21	28.6	1.5	26.9	4.1	28.6	12.4	28.9		27.7		27.4	
22	27.6	11.5	27.4	.8	27.8		29		27.6		27.5	
23	28	3.1	27.2	7.6	28.2		29		28.2		27.6	
24	27.4	1.3	27.4	1.8	27.3	19.5	29	10.2	28.5			
25	28.2		27.2	4.3	25.9	.5	28.2		28.8			
26	28.8		27.6		26.9	10.2	29.2	12.7	28.3		27.8	4.1
27	29.2	1	28.2		27.6	7.1	29.5	33.3	28		26.8	2.5
28	28.7		27.9	1.6	27.5	11.7	28.2		28.4		28.2	.8
29	29	24.1	27.2		28.1		29.2		29		28.2	
30	28.7	.3	27.6	13.4	28.6		29.2		28.7		27.4	
31	29	10.4	26.3	3.5	28.4		29		28		27.9	



"Virgen" banana, an unidentified wild species, having the fruits covered with husks.

EDITORIAL.

AGRICULTURE AND PROSPERITY.

Comparatively few years ago agriculture was looked upon in a condescending way by those engaged in other occupations, and it was generally believed that no skill and but little intelligence were needed in order to "farm." In our day and generation this sentiment has experienced a great change, for with the great discoveries and advances that have been made in agricultural chemistry, pathology, bacteriology, and thremmatology—to mention a few of the numerous 'ologies pertaining to agricultural science—it is now well recognized that in the keen competition of to-day the tiller of the soil is but poorly equipped to compete with his fellow men unless he has acquired some technical knowledge.

That the governing representatives of the enlightened nations of the world also recognize the close relation of an agriculturally well-educated farming class to the general prosperity of a country is shown by the fact that most of these countries now have well-organized departments of agriculture, and all appropriate more or less money annually for agricultural educational purposes. The place taken by a country in the family of nations with respect to its state of prosperity and its enlightenment and civilization may well be indicated by its annual appropriation for agricultural advancement and education.

It is generally conceded that of the money annually expended by the different governments of the world for various purposes, the appropriations for agricultural education are their best investments—bread cast upon the waters, as it were.

Just how soon the bread "returns" or how large a profit accrues from these investments depends largely upon those upon whom devolves the expenditure of the annual appropriations. The failure to direct the money into the right channels is not only a waste of the sums immediately involved, but nearly always it is followed by additional useless expenditures. This is the visible and, to the layman, the most conspicuous loss. The more serious consequences are loss of time and the arrest of progress.

In order that the agricultural appropriations may yield the greatest possible service to the public in the widest sense of the word, those who parcel out the sums for the various projects and investigations should have a keen perception of the relative value of these projects to the country at large and to its agricultural industries. They must also have insight to select efficient lieutenants who in turn are capable of directing and prosecuting the individual problems of agricultural research.

In accepting a position in a far country where the pressing problems of the day differ greatly from those of his former home, it behooves the investigator to cast aside his pet projects, whatever they may be, and devote himself to solving the problems that are of the greatest public concern in his new environment. Failure to do so may be justly censured. Nor is this all. The new college graduate, and sometimes even older men, when they arrive in the Tropics, are too frequently inclined to regard with disdain and sneers the agricultural methods in vogue there. It is true that many, perhaps most, practices are extremely crude and frequently the practitioner would be unable to explain the wherefore except with a "custom of the country." Yet it is well for the unseasoned to remember that many of these customs have become established through the accumulated experience of many generations, and sifted down, the underlying basis for a certain practice is frequently found to be sound and rational—and as frequently can it usually be improved upon by the intelligent man with technical education when it is "turned over," so to speak, and studied. Here is where ultimately technical agricultural education scores over the ignorant and illiterate, where the public expenditure for the uplift of the agricultural classes becomes justified, and where it becomes a great factor in elevating the general prosperity of a nation.

BUREAU OF AGRICULTURE CIRCULAR NO. 23—THE LOCUST PEST.

[CIRCULAR No. 23. Manila, July 31, 1913.]

THE LOCUST PEST.

By CHAS. R. JONES, *Entomologist*, and D. B. MACKIE, *Assistant Entomologist*.

The most troublesome and destructive pest to the agricultural interests of the Philippines as well as many other countries is the migratory locust. In the Philippines we have at least three, if not five, distinct species of this pest, and there are other species of the family Acrididæ which assume the migratory habit when conditions are favorable. From general appearance the "loctones," or young, of all species are very nearly alike, varying only in minor detail and coloration. These insects under favorable conditions develop unmolested in wild uncultivated lands, such as cogon fields—so common in these Islands—where they may remain for several generations. Sooner or later the adult insects assemble and descend upon the fertile cultivated areas in search of food or new breeding grounds. At first the migrations or flights are short, but in the course of time these swarms may traverse several hundred kilometers; thus not only the adjacent districts but those remote from the breeding areas suffer depredations from this pest.

Due to the fact that there is considerable variation in the time of hatching and consequently in the time of maturity, egg laying does not occur simultaneously with all the females of a given swarm. The oldest females stop and oviposit before the younger are mature, hence, while the locust swarm is constantly on the move, the egg deposits from a single swarm are spread over a vast amount of territory.

In the immense uninhabited cogon areas in various parts of these Islands, this pest develops unmolested, the adult insects eventually migrating to cultivated lands and causing great losses by devastating staple crops such as maize, rice, and sugar cane, likewise seriously injuring coconut palms and bamboo, and at times completely defoliating and breaking the stems and branches

of the latter by the great weight of the masses of individuals alighted thereupon. With these prevailing conditions, in order to obtain the desired results, it is necessary that the inhabitants of these Islands be fully informed regarding the habits of this pest, and remedial measures therefor, so that they may fully realize the importance of coöperation.

The average incubation period of the eggs, as shown by experiments, is from eighteen to twenty days, with a minimum of seventeen and a maximum of twenty-three and one-half; in cases of extreme drought, it is possible that a month might pass between oviposition and the emergence of the young locusts.

The young nymphs, or loctones, closely resemble the adult, except that they are wingless and have disproportionally large heads. Within a few hours after emerging from the egg mass the young hoppers display ravenous appetites, eating almost every kind of green herbage within their reach. Sweet potatoes, tobacco, beans, and mongo suffer little or no damage. Hard substances, such as stalks of maize, sugar cane, and stems of shrubs, usually escape destruction, though buri and coconut leaves are not exempt from the attacks of the "voladores," or adults.

The hoppers do not feed as much at night as do the adults, but usually "go to roost" at dusk, clinging to stems of grass or plants.

The nymphs are very active during the warm part of the day. The migratory instinct is early in evidence and the young insects begin to move in a definite direction after the first day or two At first only a few meters per day may be covered, but when they are ready to molt the last time, 3 or 4 kilometers per day may be traversed.

The average time required for the nymphs to reach maturity is about fifty-four days.

When all the hoppers in a swarm have acquired wings they usually remain a few days flying promiscuously about in the immediate vicinity of their previous operations. After a few short local flights, the migratory instinct asserts itself, and the entire swarm mounts into the air and proceeds (usually with the wind) at the rate of about 30 kilometers per day to a new breeding ground. Little is known of the exact conditions influencing the direction and extent of the flight of these swarms. Occasionally a swarm retraces its flight several times before becoming satisfied with a site for egg laying.

The adult locust is very active and readily takes flight at the slightest alarm. A distinct odor is given off by the mature in-

sects and the presence of a swarm may be detected at a distance of several kilometers. The hoppers exhale a similar effluvium, but to a lesser degree than the adults.

Soon after mating the females become heavy with eggs; they do not fly with such ease as before and are sluggish. In this state they readily fall a prey to many birds and animals. After oviposition they do not live long, thus in old swarms the males preponderate.

The fact that the female deposits the entire number of her eggs in one cluster is of great importance in the work of locust destruction; unfortunately, however, all the females of a given swarm do not oviposit at the same time or in the same locality.

As evidence of the extreme degree of the gregarious sense of the migratory locust, it is well to mention that, under ordinary conditions, the number of egg clusters varies from 4,000 to 5,000 per square meter. This does not mean, however, that this number of adults could be found in such a space at any given time. From these figures we see that from each square meter of soil surface where oviposition takes place we could have from 200,000 to 300,000 young hoppers. Multiplying these figures by 10,000 we begin to realize the number (2 to 3 billions) that may emerge from 1 hectare of ground.

CONTROL OF THE PEST.

The control of the migratory locust may be studied under two heads: Artificial, which includes all methods of human control, such as spraying, driving into pits, netting, crushing, burning, inoculating, poisoning, etc.; and natural control, which includes all climatic conditions, predaceous insects, birds, animals, and parasites.

The complete destruction of a winged swarm is practically impossible, though under favorable conditions a very large portion may be caught in nets, or, more rarely still, killed by means of a contact spray, such as kerosene. Therefore, the attention of those engaged in locust-destruction work must be directed against the eggs and hoppers.

The destruction of the eggs in cultivated ground is a matter of great importance and, whenever practicable, should be carried out as thoroughly as possible. In fields where locusts have oviposited, plowing the ground is sometimes very effective, but it by no means insures the destruction of all egg clusters. Where a plow with a moldboard is used, a thorough plowing is usually sufficient to bury nearly all egg masses to such a depth that when

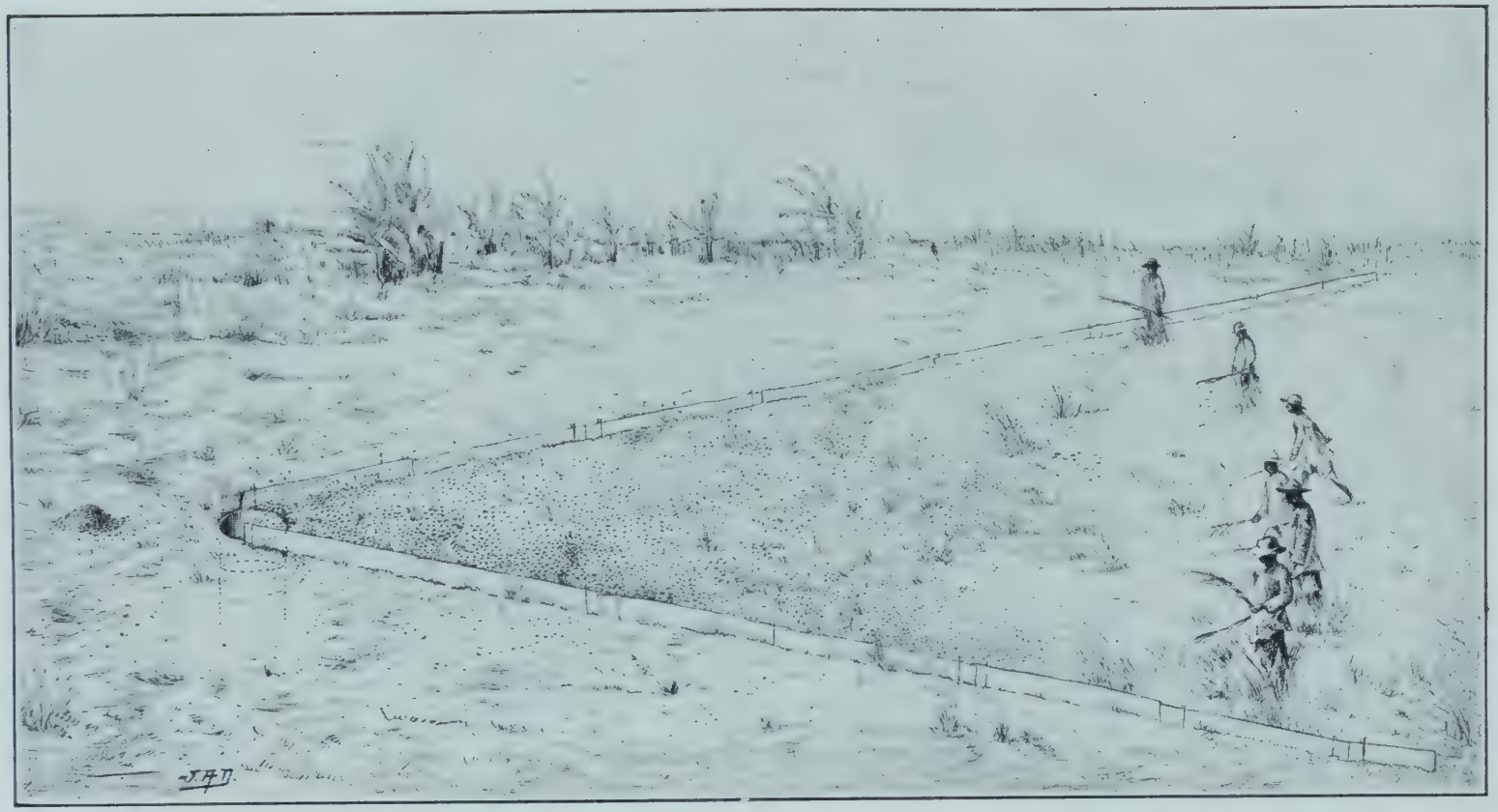
the hoppers hatch they are unable to make their escape from the earth and are consequently smothered. When the ordinary Filipino plow is used it is necessary to either roll the land directly after plowing or pack it by means of hand mauls. In land where a plow cannot be used, excellent results may be obtained by digging out the eggs by hand and either crushing them or destroying them by the use of boiling water.

APPROVED METHODS OF HOPPER DESTRUCTION.

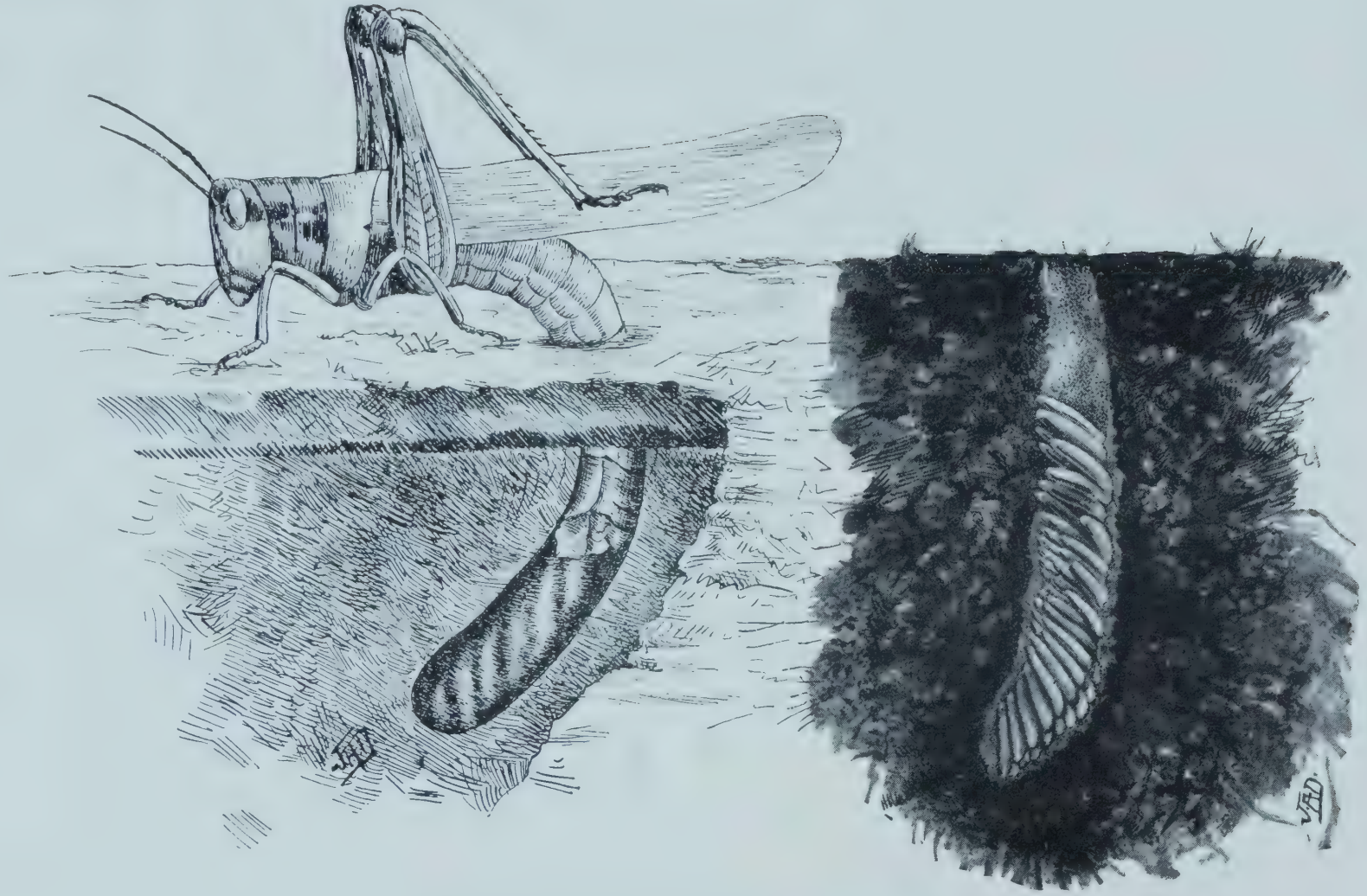
Pit, or driving, method.—By far the most important method of combating the young insects is the common pit, or driving, method. While there are conditions under which this method cannot be used with very good results in cultivated ground, it is usually the best to follow. Its application is not only simple, but the Philippine planters in every province have been more or less familiar with this method for many years. In cases where no roofing iron is available earthen dikes faced with sections of banana sheaths constitute a very effective substitute; the leaf blades of the banana should not be used unless the swarm is a small one, because the insects quickly devour the green portion of the leaf.

Considerable care should be taken in the construction of these pit fences in order that the loctones may not escape through joints between sheets, and that no brush or grass be left in such a position that the insects can climb over the fence. At the point of the V-shaped structure a pit about 1 meter wide, 1 meter deep, and 1 meter long should be excavated to receive the insects. The upper edge of this pit should be faced with iron sheets, banana-leaf sheaths, or at least banana leaves, to prevent the hoppers from crawling out of the pit.

Generally speaking, the pit fences should be erected a short distance, say 20 meters, in front of the advancing swarm; after both the fence and pit have been constructed, as many men and boys as the size of the swarm may require take their places behind the swarm, and with sticks and branches urge the loctones toward the pit. Inexperienced drivers in their zeal sometimes confuse the hoppers by forcing them to travel too rapidly, and thereby cause the swarm to become a widely straggling mass, whose movements cannot be directed for some time thereafter. Under ordinary circumstances, after the construction of the fence and pit, the entire swarm, if of moderate size, i. e., covering only some 100 square meters or more, should be inside the pit within one hour from the beginning of the drive.



Showing manner in which corrals and pits should be constructed in pit or driving method of locust destruction.



Migratory locust depositing eggs, and eggs in soil.

The methods of destroying the insects in the pit are of secondary importance, the most common and one of the best being trampling with the feet; covering with earth, or tamping with heavy sticks or mauls, is equally simple and effective.

Nets.—On level ground a large cone-shaped net, or bag, may be used to destroy the young hoppers with considerable success. The side of the net which comes in contact with the earth should be held straight by means of a straight stick; the upper part of the net should, of course, have a piece of rattan or a bow-shaped piece of wood attached to the rim to hold it wide open. In certain cases extra large nets for use with horses (carabaos being too slow) may be used. Both in India and Argentina large nets drawn between trotting bullocks or horses are used with good success.

The insects caught in the bottom or rear portion of the net may be killed either by crushing or by dipping into hot water. The net should be constructed of coarse cloth—either canvas or gunny-sack material.

Nets having a circular frame for keeping the mouth open and mounted on short stiff handles may be used to good advantage in capturing the fliers; even when "roosting" the winged insects may be taken in large numbers by beating these nets against the herbage and shrubbery where the insects have settled.

Rolling.—In young cogon grass on level ground a section of buri-palm trunk, or a straight smooth log, at least 40, and better 60, centimeters in diameter, drawn by carabaos or cattle attached to either end, may be used to crush the loctones with considerable success.

Burning.—Where the young hoppers are hidden in grass and brush on rough ground, it is sometimes feasible to cut the herbage over the infested area and set fire to it as soon as it becomes dry enough to burn. This, of course, will also apply to an area in which it is definitely known locust eggs are about to hatch. As soon as the locusts appear and collect upon the dried grass and brush they may be almost completely destroyed if the material for burning be in fair quantity. The burning method is particularly practicable in the cogonales in uncultivated districts.

Insecticides.—Locusts in any stage of development may be killed either by contact sprays or by poison solutions. The simplest method is perhaps kerosene, or any of the light crude petroleum oils, used as a direct-contact spray. In or near barrios where there are valuable crops it is in many cases practicable to spray the insects with kerosene, using cheap hand pumps,

the kerosene being carried in metal buckets or even in the original tins; this may also be used very effectively upon the fliers while "roosting" at night, though it is much more effective on the young loctones.

For general field work, however, the kerosene-spray method cannot be recommended very highly on account of its expensiveness; a modification of this, known as the kerosene-emulsion method, is very much cheaper and may be used very advantageously on young hoppers in open areas. This emulsion is made by mixing kerosene with soap and water to form a dilute mixture or emulsion, the soap holding the kerosene in suspension; even very dilute mixtures are effective against the very young hoppers.

Unfortunately, the use of arsenical poisons is usually attended with serious danger for the following reasons: (1) The Philippine planter is in general unfamiliar with poisons and the methods for using them; (2) there is always more or less danger of poisoning domestic animals through their feeding upon the poisoned grass; (3) many beneficial birds which normally feed upon locusts might be killed by eating the poisoned insects. In special cases, however, such poisons as lead arsenate, Paris green, or a sweetened mixture of white arsenic may be used by experienced persons with very good effect.

The cannibal habits of the locust are of great importance in using arsenical sprays, for as soon as the first insect in the advance of the swarm becomes affected by the poison he is devoured by his companions, which, of course, are also killed by the poison contained in the first body and so on for at least three, if not four, cycles.

COÖPERATION.

The eradication of the locust plague in a given province can be accomplished by systematic and coöperative work. This was demonstrated and proved by the governor of Iloilo in 1910. Failure on the part of some municipal and provincial officials to enforce the provisions embodied in Act 2121 is deplorably common. The principal objection to the said act seems to be that certain officials regard it as a hardship upon the people if compelled to work as prescribed by this law. Thus it may happen that the people of an infested barrio work diligently while those of the central part of the town are not compelled to assist and therefore do not work at all.

In order to bring the work upon the majority of the people

each cedula-buying person of any given municipality should be compelled to work while the danger lasts at least one day per week. This will increase the efficiency of the campaign and the swarms of locusts in question can sooner be brought under control.

As a sample case, the following table, compiled from the official reports from infested municipalities, gives the number of persons working and the results accomplished:

Official municipal reports as to the number of infested areas and number of persons working.

Municipality.	Dates inclusive.	Infested sites.	Total people working.	Days worked.	People per day.	People per site.	Total cavans of locusts destroyed.	Cavans destroyed per day.	Average cavans per person.
No. 1	Oct. 15 to Oct. 27	5	137	12	27	2.25	472	39.33	1.4
	Oct. 27 to Nov. 8	16	563	12	35	2.9	530	44.1	1.2
	Nov. 8 to Nov. 20	9	275	12	30	2.5	581	48.4	1.6
No. 2	Oct. 20 to Oct. 31	7	51	10	5	.5	394	39.4	7.8
	Nov. 1 to Nov. 10	16	168	10	17	1.7	663	66.3	3.9
	Nov. 11 to Nov. 20	20	110	10	11	1.1	193	19.3	1.7
	Nov. 21 to Nov. 30	13	94	10	9.4	.94	179	17.9	1.9
No. 3	Nov. 1 to Nov. 10	19	292	10	19.2	1.92	804	80.4	4.2
	Nov. 10 to Nov. 20	23	424	10	42.4	4.24	971	97.1	2.08
	Nov. 20 to Nov. 30	5	69	10	6.9	.69	66	6.6	.9
No. 4	Sept. 21 to Sept. 30	6	228	10	22.8	2.28	261	26.1	1.1
	Oct. 1 to Oct. 10	13	282	10	28	2.8	652	65.2	2.3
	Oct. 11 to Oct. 20	12	520	10	52	5.2	1,525	152.5	2.9
	Nov. 1 to Nov. 10	4	97	10	9.7	.97	1,000	100	1
	Nov. 11 to Nov. 20	8	345	10	34.5	3.45	1,315	131.5	3.8
	Nov. 21 to Nov. 30	1	25	10	2.5	.25	150	15	.6
No. 5	Sept. 28 to Oct. 8	12	514	10	51.4	5.14	96	9.6	.1
	Oct. 8 to Oct. 18	15	382	10	38.2	3.82	199	19.9	.5
	Oct. 18 to Oct. 28	21	532	10	53.2	5.32	240	24	.4
	Oct. 28 to Nov. 8	21	522	10	52.2	5.22	731	73.1	1.4
	Nov. 8 to Nov. 18	16	267	10	26.7	2.67	562	56.2	2.1
No. 6	Sept. 30 to Oct. 9	12	150	10	15	1.5	52	5.2	.4
	Oct. 10 to Oct. 20	4	96	10	9.6	.96	40	4	.04
	Oct. 21 to Oct. 30	5	84	10	8.4	.84	53	5.3	.6
	Nov. 1 to Nov. 10	11	197	10	19.7	1.97	112	11.2	.5
	Nov. 11 to Nov. 20	12	417	10	41.7	4.17	298	29.8	.7

From this it can readily be seen that many of the locust swarms were left to develop more or less unmolested. Taking a general average, at no time did the average maximum number of individuals working per day on any given swarm reach more than 5 persons. The municipalities used in the above example are all second or third class, and have at least 14,000 inhabitants, i. e., at least 3,600 taxpayers or cedula-buying persons. Now, if every person having a cedula were compelled to work one day per week it would mean 14,400 day laborers per month, which would give 480 laborers per day; taking the general average of 12 infested areas per municipality, 40 persons would be available where this table shows only from 1 to 5.

Act 2121 provides that all able-bodied inhabitants—with few exceptions—of the Philippines shall work in locust destruction when the pest occurs. All these cannot be reached or a check kept on them, but the maximum number of persons can be obtained by proper municipal organization, as follows:

1. Oblige all taxpaying persons to work one day each week.
2. Divide the municipality into districts.
3. Assign certain days to certain members of the municipal council or lieutenants of barrios to record the number of the cedulas of persons working.
4. Fine all persons whose cedula numbers do not appear upon the roll four times per month, in accordance with paragraph 6 of the revised locust resolutions. Deposit all locust fines collected in a special fund for locust work.
5. Pay all persons whose cedula numbers appear more than the required number of times a small daily wage from the said fines fund.

THE TOBACCO CATERPILLAR (*Prodenia litura* Fabr.).

By CHARLES R. JONES, *Entomologist.*

Tobacco is one of the staple crops of the Philippine Islands and though the output at present is slightly less than in former years it still stands near the head of the list of Philippine products. The principal tobacco-growing district is in northern Luzon in the Provinces of Cagayan and Isabela, although it is produced to a greater or less extent throughout the Archipelago. In these provinces considerable damage is done by insect pests.

The greatest pest in these sections is *Prodenia litura* Fabr., belonging to the order Lepidoptera, family Noctuidæ. The larva of this moth attacks growing tobacco, both young and old, but the greater damage is done to the young leaves, since even a small hole made in the bud or growing leaf assumes considerable proportions as the leaf develops.

The pest is also present to a greater or less extent in various districts where tobacco is not cultivated, and, since it frequently attacks the various garden and field products, remedial measures are worthy of consideration. It is therefore the object of this paper to give remedial measures and to acquaint the planters with the habits and life history of this pest.

CLASSIFICATION AND SYNONYMY.

This insect belongs to the family Noctuidæ, subfamily Trifinæ, and was first described by Fabricius in 1775 as *Noctua litura.* There is a great variation in the color markings of the adult, hence this insect has been at various times described as a new species, and therefore it has an extended synonymy. Hampson in his Fauna of British India, Moths (1894), designates this species as *Prodenia littoralis,* but later in his Catalog of Lepidoptera Phalænæ (1909) he establishes it as *Prodenia litura* and gives the following synonymy:

Noctua litura Fabr., Syst. Ent. (1775), 601.
Noctua histrioniæ Fabr., Syst. Ent. (1775), 612.
Noctua elata Fabr., Spec. Ins. (1781), 2, 220.

Hadena littoralis Boisd., Fauna Ent. Mad. (1833), 91, pl. 13, fig. 8; Moore, Lep. Ceyl. (1887), 3, 19, pl. 146, figs. 1 *a*, *b*; Hamps., Fauna Br. Ind., Moths (1894), 2, 247; Staud., Cat. Lep. pal. 184.
Hadena retina Frr., Neuebeitr (1846), 5, 161, pl. 474, figs. 2–3; Herr.-Schaff., Eur. Schmitt. Noct., figs. 144–145.
Prodenia tasmanica Guen., Noct. (1852), 1, 163.
Prodenia ciligera Guen., Noct. (1852), 1, 164.
Prodenia tastaceoides Guen., Noct. (1852), 1, 165.
Prodenia subterminalis Wlk. (1856), 9, 196.
Prodenia glaucistriga Wlk. (1856), 9, 197.
Prodenia declinata Wlk. (1857), 11, 723.
Manusctra albisparsa Wlk., Journ. Linn. Soc. Zool. (1862), 6, 186.
Prodenia evanescens Butl., Men. Nat. Ac. Sci. Wash. Rep. Eclipse. Exp. (1884), 94.
Prodenia litura Fabr. (Hamps.), Cat. Lep. Phalænæ (1909), 7, 245.

HISTORY AND DISTRIBUTION.

This insect has an extended range as its habitat, Swinhoe[1] giving Australia, Borneo, India, and the Philippines as localities from which it has been recorded, while Hampson[2] has a larger scope including all South Sea Islands, New Guinea, Australia, Malay Archipelago, India as far as Sekhim, Sunda Islands, Japan, China, Turkey, Syria, Africa (from Uganda, Natal, Mashonaland, and Mauritius), and Lefroy[3] states it is common throughout India and occurs in the Himalaya and Nilgiri Mountains as well as the plain districts.

OCCURRENCE AND FOOD HABITS.

This pest has frequently been reported to this office from the Visayan Islands as damaging corn, and specimens have been received from the Province of La Union where it was reported as doing considerable damage to tobacco. It occurs also throughout the Cagayan Valley, especially in the tobacco fields from Lal-loc to San Luis. It is known throughout that district as the "camarin worm" and it is generally believed to develop in the camarines, or sheds, *in a single night*, when in reality it develops in the field and is gathered with the tobacco leaves and taken into these storehouses. When the tobacco wilts these "worms" leave it and search for more suitable food; it is then that they are discovered by the planters.

The larvæ of this insect can be found in their various stages at almost any time where the castor plant occurs, being partic-

[1] Catalog of Eastern Lepidoptera-Hetorocera.
[2] Cat. Lep. Phalænæ (1909), 7, 246.
[3] Memoirs of the Department of Agriculture in India (1908), II, No. 5, 79–93, pl. 1.

ularly fond of the tender succulent leaves of that plant. In fact, they are such general feeders that they will eat almost any kind of green vegetation. The writer has found them feeding upon the following plants:

Tomato, attacking both the leaves and fruit.
Tobacco, feeding upon the leaves.
Calaboa (*Monochoria hastata*), feeding on the leaves.
Maize, feeding upon the leaves of small plants.
Cabbage, the leaves.
Rice, eating the leaves.
Sweet potato, feeding upon the leaves.
Castor (*Ricinus communis*), feeds upon the leaves.
Jimson-weed (*Datura* sp.), feeds upon the leaves.

To this may be added the food plants recorded by Lefroy [1] of India:

Lucerne (*Medicago sativa*), abundant on irrigated lands.
Jute (*Corchorus capsularis* and *C. olitorius*), feeds upon the succulent apical shoots.
Indigo, noted in August but not especially serious.
Potato, cutting off young plants.
Mulberry (*Morus alba*), eating the leaves.
Pakur (*Ficus infectoria*), eats the leaves.
Maruá (*Eleusine coracana*), scarce.
Ground nut (*Arachis hypogæa*), feeds upon the leaves.
Urid (*Phaseolus radiatus*), occasionally.
Tur (*Cajanus indicus*), feeds on leaves and pods.
Sugar cane (*Saccharum officinarum*), feeds on the leaves.
Agathy (*Sesbania ægyptiaca*), feeds on the leaves.
Coleus, found occasionally in gardens.
Dhaincha (*Sesbania aculeata*), feeds on the leaves.

The adults seem to be not at all particular in selecting host plants for oviposition, but lay their eggs on whatever species is convenient, and the larvæ seem to thrive on whatever food is at hand.

LIFE HISTORY.

Eggs.—The eggs of this moth are laid in clusters (fig. 1, *a*) on either the top or bottom of the leaf, the greatest number of clusters having been noted on the top of the leaf. The clusters of eggs vary in number from 35 to 500 eggs. They are arranged in rows and the mass generally contains three layers, the whole egg mass being covered with short buff-colored hairs that are obtained from the anal tuft of the moth. This hairy covering undoubtedly acts as a protection against parasites.

[1] Memoirs of the Department of Agriculture of India, 1908, 11, No. 5; 91–92.

The egg is rounded and ridged, pearly white when freshly laid, growing darker as it stands; the shell is rather tough and not easily broken; average period of incubation three days. There is considerable uniformity in the time of hatching of the eggs in each mass.

Larva.—The newly hatched larva averages 1 millimeter in length and is greenish in color; body cylindrical. When disturbed it curls up like a cutworm and suspends itself from the

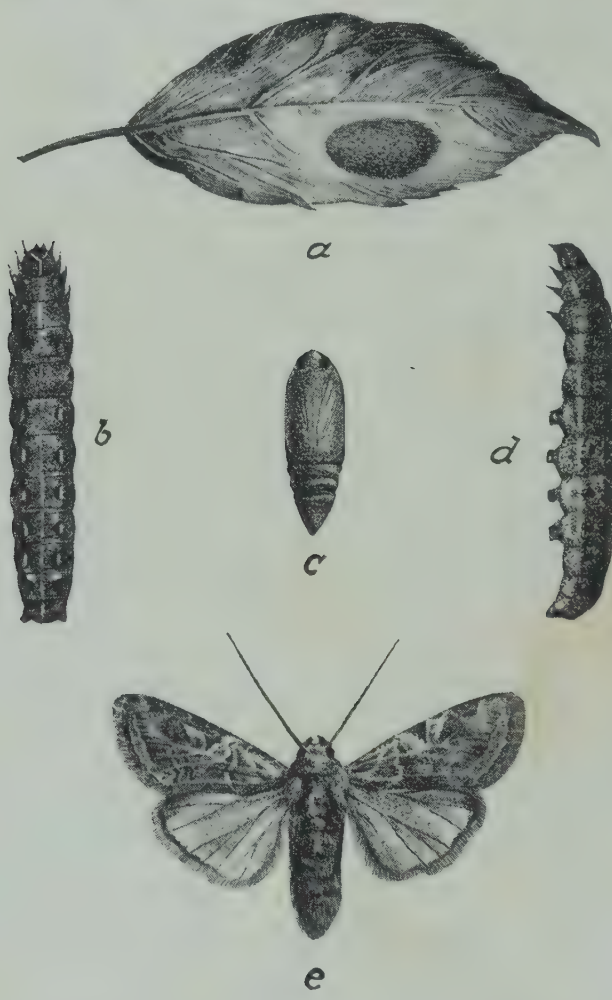


FIG. 1. *Prodenia Litura* Fabr. *a*, egg cluster on leaf; *b*, larva, dorsal view; *c*, larva, lateral view; *d*, pupa, ventral view; *e*, adult.

plant by a tiny silken thread. The larvæ feed upon the epidermis of the leaf working from the under side and sometimes completely skeletonizing it; they keep close together in masses for three to five days. Plate IV, *a*, shows the appearance of castor leaves attacked by young larvæ of this species; tobacco leaves have about the same appearance, but are not skeletonized to such an extent, as the leaf tissue is of a thicker texture. In feeding thus, in masses, the bodies of the larvæ are generally parallel with the heads all pointing in one direction (Pl. IV, *b*).



(*a*) Skeletonized castor (Ricinsus communis) leaf, caused by feeding of the tobacco-caterpillar larva.



(*b*) Showing young larvæ of the tobacco caterpillar; when first taken the larvæ were all side by side as at X. Upon the leaf tissue wilting, the larvæ have begun to wander about.

The first molt occurs in about two to four days after hatching, and the second about three days after the first. The coloration changes are considerable and the dark transverse band of the first abdominal segment becomes very pronounced. If food is still abundant the larvæ remain in masses or small groups, otherwise they begin to scatter. After the third molt they become very active and move about freely. They now consume the entire tissue of the leaf and do not confine themselves to the epidermis as in the first three stages.

During the process of development this caterpillar passes through five instars. The full-grown larva (fig. 1, *b*, *c*) may be easily recognized from the following description:

Head smaller than following segment, bilobed, black, slightly hairy, cervical plate triangular, bordered with white. Antennæ and cheeks pale yellow; ocelli, mandibles, and maxillæ brown. Body cylindrical, bearing five pairs of functional prolegs; ground color brownish-black, tinged with orange, varying considerably among individuals. First thoracic segment with a dark spot laterally, just above first pair of legs, bearing two hairs each. Second and third thoracic segments with two bright-yellow spots. Three yellowish spots dorso-medial, in some cases displaced by a line; two light-brownish lateral lines one above and one below spiracles; above the top line is a broken line composed of velvety, semicrescent patches, varying among individuals. Spiracles orange. Feet black, prolegs brownish, gradually fading into orange, in some cases the brown leaving off abruptly. Anal plate brownish with orange dot at base. Length 4.5 centimeters, width 5 millimeters.

When full-grown and ready to pupate the larva crawls down the plant, enters the soil to a distance of about 7 or 8 centimeters, and forms an earthen cell wherein it transforms to the pupa and adult. The average duration of the larval stage as observed is 17.2 days.

The pupal cell averages 22.5 millimeters in length and 9.28 millimeters in width.

Pupa.—The pupa (fig. 1, *d*) is of the general noctuid type: Elliptical; surface shiny, dark reddish-brown; head rounded, smooth, antenna-case rather prominent; abdomen with three movable incisures; spiracles very dark in center; cremaster composed of two prolonged spines curved inwardly, light at tips, almost invariably entangled in last larval molt; wing-covering darker than rest of the body; average length of pupa without cremaster, 18.9 millimeters. Average duration of pupal stage is 9.6 days.

Adult.—The adult (fig. 1, *c*) of this insect remains very quiet during the daytime and usually conceals itself in darkened places. It rests with the wings held closely in to the body; when disturbed it flies quickly with a zigzag movement. During the night the moths fly about and feed on nectar of flowers. Oviposition occurs early in the evening and at night. In the laboratory they were noted to live from four to eight days when fed on sweetened water, but the length of life is undoubtedly longer under natural conditions. Copulation occurs soon after emergence. Egg laying commences two to three days after emergence. They deposit their eggs in clusters as before described, and as few as 35 eggs have been noted in a cluster. The general average number per mass is between 200 and 350 eggs. Some individuals were noted to lay five different clusters with a total of 518 eggs.

The following table gives the life cycle as worked out in the laboratory at Manila:

Table showing life cycle of Prodenia litura Fabr.

Observation No.	Individuals observed.	Eggs.			Larvæ.		
		Laid.	Hatched.	Days.	Hatched.	Pupated.	Days.
1	7	Mar. 6	Mar. 9	3	Mar. 9	Mar. 27	18
2	2	do	do	3	do	do	18
3	3	Mar. 7	Mar. 10	3	Mar. 10	do	17
4	2	do	do	3	do	Mar. 28	18
5	3	Mar. 8	do	2	do	Mar. 26	16
6	2	do	do	2	do	Mar. 28	18
7	1	do	Mar. 11	3	Mar. 11	do	17
8	3	Apr. 9	Apr. 11	2	Apr. 11	Apr. 30	19
9	2	do	do	2	do	do	19
10	5	Oct. 13	Oct. 16	3	Oct. 16	Oct. 28	12
Average				2.6			17.2

Observation No.	Pupæ.			Adult.			Total life cycle.
	Pupated.	Emerged.	Days.	Emerged.	Died.	Days.	
1	Mar. 27	Apr. 5	9	Apr. 5	Apr. 10	5	35
2	do	Apr. 6	10	Apr. 6	Apr. 14	8	39
3	do	do	10	do	Apr. 10	4	34
4	Mar. 28	Apr. 7	10	Apr. 7	Apr. 11-12	4-5	35.5
5	Mar. 26	Apr. 7-8	10-11	Apr. 7-8	Apr. 10-12	3-4	32
6	Mar. 28	Apr. 9-10	12-13	Apr. 9-10	Apr. 13-14	4	36.5
7	do	Apr. 8	11	Apr. 8	Apr. 12	4	35
8	Apr. 30	May 6	7	May 6			
9	do	May 7	8	May 7			
10	Oct. 28	Nov. 5	8	Nov. 5			
Average			9.6			4.7	35.5

CONTROL.

Parasites and predaceous enemies play an important part in the natural control of this pest. Although the eggs are fairly well protected by their hairy covering, two small hymenopterous

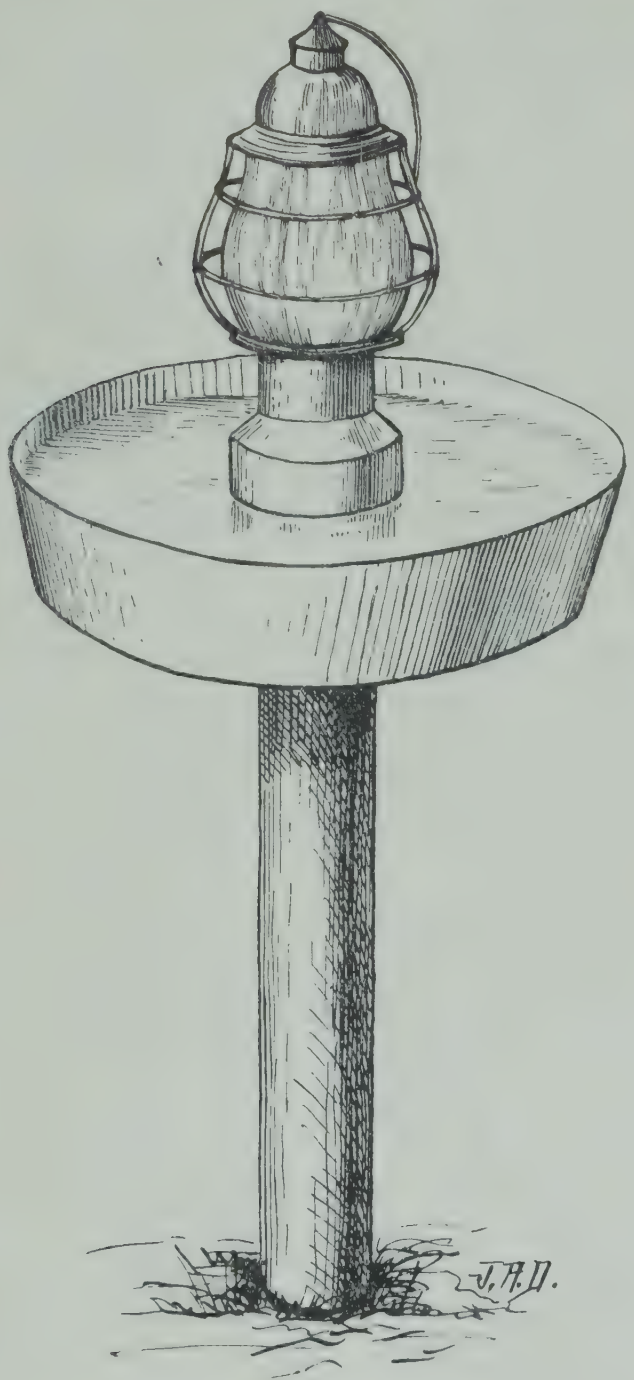


FIG. 2. Light trap, used for catching adults of the tobacco caterpillar. The basin under the light is filled with water and a small quantity of kerosene.

parasites have been bred therefrom in large numbers. A large Tachinid fly has also been bred from the larvæ and a large black mud-dauber wasp was observed several times carrying off the larvæ.

Birds also play an important part in the natural control of this pest, but to what extent has not been definitely determined.

When these larvæ appear in numbers sufficient to warrant it, they may be controlled by an application of Paris green or arsenate of lead. The latter is preferable, as it does not have the burning qualities of the former and may be applied at a more concentrated strength without any ill effects to the plant.

After the planter becomes familiar with the habits of this pest, and if it does not appear in too great numbers, he can easily prevent damage to his crop by hand picking; the deposition of eggs in masses and the social habit of the larvæ facilitate this method. Observations should be made at various intervals of the growing crop to ascertain whether or not this pest is present, and if so, active measures should be commenced at once. The moths are attracted to lights and may be trapped by placing lights over basins of water and kerosene (fig. 2) in various parts of the field. The moths that fly to these traps will fall into the water and oil and be killed.

THE BUREAU OF AGRICULTURE BANANA COLLECTION.

By O. W. Barrett, *Chief, Division of Horticulture.*

Everything considered, there is probably no more important fruit in the whole realm of horticulture than the banana. It is certainly the most widely known of all the fruits, and is one of the most nutritious, one of the most productive, and one of the most easily cultivated fruits of any clime or country. Unfortunately, the bananas and plantains of the world have never been carefully studied, however, with the object of determining which varieties are best for home use, which for commercial export, and which for manufactured products ("figs," flour, "coffee," chips, etc.); neither have they been studied with a view of working out the synonymy of the varieties. This is a curious fact, considering the length of time during which banana collections, more or less limited to be sure, have been under observation in the various tropical stations in the colonial dependencies of European nations.

One reason, however, which may partially account for the neglect of this class of fruits is the fact that very few of the cultivated sorts produce viable seeds, while the suckers, or offsets of the parent stem, require expert handling in order to be transported successfully over long distances. It is now quite certain, however, that there are at least two possible methods of sending banana roots over practically any distance—for instance, from Porto Rico to the Philippines: The Wardian-case method of transporting small living plants in a ventilated glass-covered shipping box; and the dried-root method of packing the "cured" bulb-like base of the sucker in a ventilated package of *mailable* size.

About eighteen months ago the Bureau of Agriculture formed a definite plan for banana-investigation work and at the beginning of the last fiscal year a small sum of money was set aside under a special project for the furtherance of this idea. Without making a special effort during the first half of the last

fiscal year (July to December, 1912) a remarkably large number of indigenous Philippine varieties was assembled and planted out at the Alabang stock farm. During the latter half of that year a more systematized effort was made toward getting banana varieties from neighboring foreign countries to be tested alongside the Philippine collection; and recently letters have been sent out to the presumably favorable districts of the Archipelago requesting the municipal presidents of those districts to furnish the Bureau a list of the varieties grown in their neighborhoods, and to send one root each of all varieties which in their opinion were not to be found in the vicinity of Manila. Letters were also sent to several of the neighboring foreign countries requesting assistance in this line of work, with the idea of exchanging first-class Philippine sorts for the varieties obtainable in those countries.

Both these methods of arousing interest in the Bureau's collection are giving every assurance of success and already a very considerable number of interesting varieties have been added to the list.

There is no question but that the banana industry should be a profitable one here in the Philippines. The plants grow well unless troubled by unusually severe droughts and typhoons; there are practically no severe insect pests, the leaf-roller butterfly and the root-grub weevil being the only ones known at present worthy of consideration. Two years ago a banana disease was discovered which, it was feared, might cause severe losses in plantations, but this trouble no longer causes anxiety since it appears that most varieties, except the Dwarf or Chinese, are resistant to this disease, and besides the few outbreaks which have been noted have practically disappeared without expensive measures being employed to combat them.

On the other hand, the demand for good market bananas is constant and strong. The price of an ordinary bunch of bananas in the Manila market is about three times what it should be, considering the price at which these fruits are sold in other tropical countries. Furthermore, the assortment of varieties to be had in any given locality of the Archipelago is deplorably meager; where there should be always in evidence not less than twenty-five varieties to meet the various requirements, such as fresh fruit to be eaten "out of hand," sorts for boiling, baking, and frying, we usually find here but five or six kinds and these the *easiest to grow* instead of the *best to eat*. In order to know just what sorts should be propagated on a large scale for distribution,

it is necessary that comparative tests be made including as many native and introduced varieties as possible; and, by the same token, it is practically impossible, without spending a great deal of time and money in traveling, to say definitely just what are the synonyms of any given variety. For instance, it may be probable that the Tindoc, Todoc, and Tumoc are one and the same variety of plátano, having different names in several provinces, but it is a more difficult matter, before a comparative fruiting test is made, to say whether the Bongoyan, the Bangalan, the Bangaan, and the Bungolong are all dialectal variations of the same varietal name. On the other hand, it has already become clear in the course of this work on the present collection that there are several distinct sorts of Lacatan, several of Sabá, and several, also, of Morado, although it appears that very few Filipino planters or market vendors recognize the real variational differences.

A monograph of the bananas has recently appeared; but having been made, apparently, without a large, not to say complete, collection of fruiting specimens in evidence for comparison, it follows that the descriptions and general classification of the group are necessarily of but little use to the musologist of the future. It is of great interest to note that several species—probably not less than ten—of the genus *Musa* are native to the Philippine Archipelago and quite possibly several of these have never been described by botanists.

Though there is some variance of opinion among phytogeographers as to the origin of bananas, the consensus is very strongly in favor of the Indo-Malayan region as the home of at least a large part of the Musas. Tropical Africa contains a great number of wild and semicultivated species and varieties besides a considerable number of cultivated sorts which very evidently have been introduced from the Indo-Malayan region. It is practically certain, however, that a few varieties, at least, of bananas and plantains were existent in the New World before the arrival of Columbus. Throughout the entire Malay Peninsula, Assam, and the back districts of Siam and Indo-China, there are probably a large number of little-known species and varieties of wild and semicultivated sorts. Some of these were undoubtedly the parents, so to speak, of the varieties now under cultivation throughout the Tropics. The archipelagos of the Pacific are also the habitat of certain types not found to any extent outside of that area; for instance, the Fehi type, which bears the fruit bunch upright above the plant stem, does not

occur, so far as we know, in the Philippine Archipelago or Malaya and is believed to be found in only one or two small districts in the Hawaiian Archipelago.

Several of the groups of islands in the Pacific formerly possessed a rather large indigenous banana flora and the natives of those islands were dependent to a great extent upon those varieties for food previous to the arrival of the white planters. Upon the opening up of sugar plantations in the lowland valleys, the demand for laborers and the exigencies of civilizing processes practically forced the inhabitants of the island interiors down to the coastal plains, thus leaving the original banana plantations and gardens largely at the mercy of rampant jungle vegetations as well as exposed to the depredations of wild pigs, cattle, etc. Thus, in the larger islands where fifty years ago it would have been easy to collect within a few days 25 to 50 varieties of edible bananas and plantains, to-day the assembling of even half that number in the same locality might require several weeks' hard work. It is even probable that some very interesting and practically unique types have been utterly lost to horticulture on account of this fact.

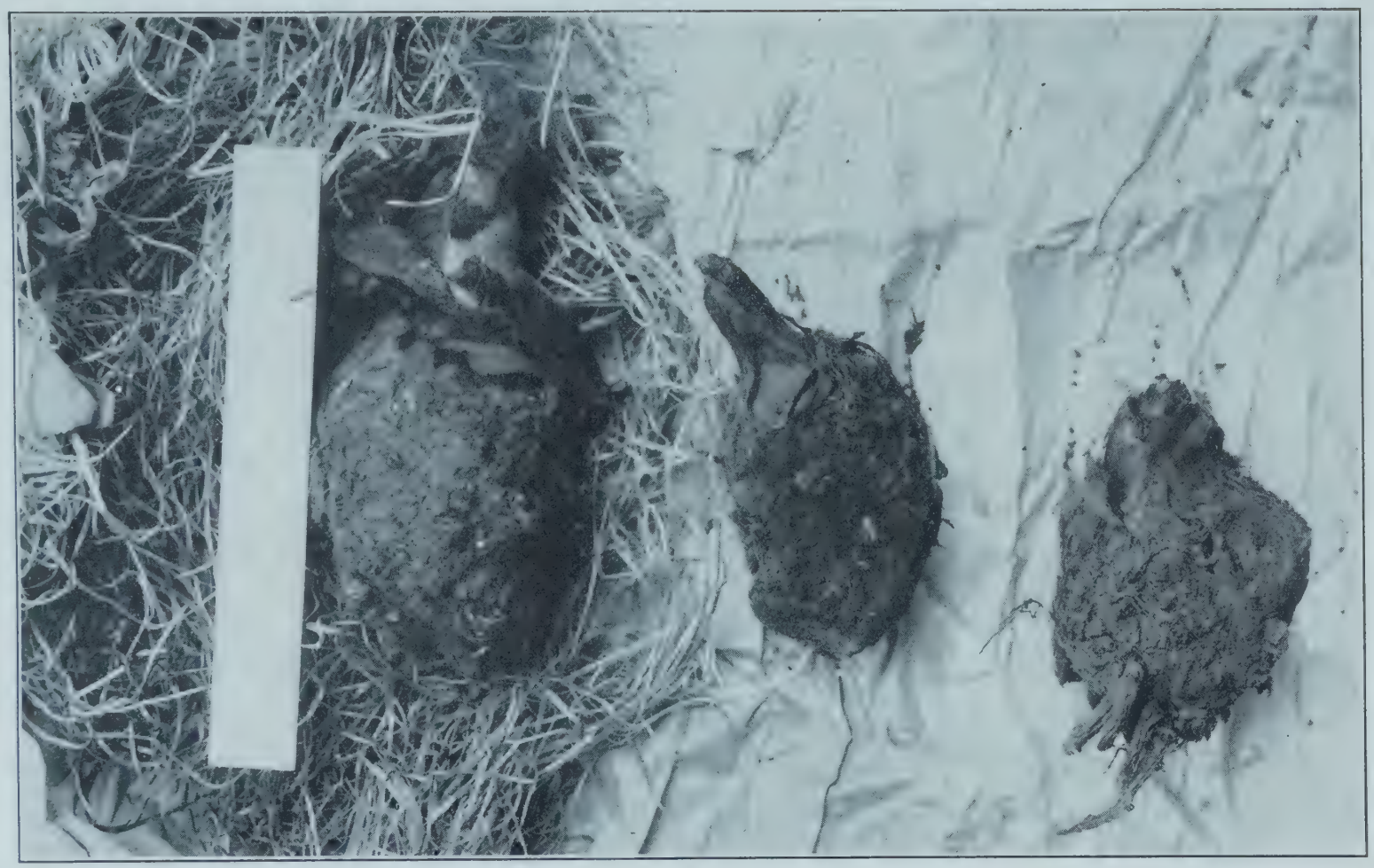
It seems, then, that as all the other tropical countries have neglected this important piece of horticultural investigation, it now behooves the Philippine Bureau of Agriculture to make earnest effort to carry to a practical conclusion these two lines of study: The trying out of presumably commercially profitable varieties from the planters' standpoint, and the working out of the question of synonyms, or name duplication, of the principal varieties obtainable with a reasonable amount of time and expense. It will never be possible, perhaps, to collect all the 250 to 350 kinds of bananas in one experimental plantation, but if the planters, horticulturists, and botanists of the Tropics will lend their assistance we shall soon have a collection of these fruits as the basis of accurate information which will be a landmark in the history of tropical horticulture. In fact, it is practically certain that never before have there been brought together so many varieties as are already in evidence at the Alabang stock farm and the Singalong experiment station.

The following varieties of Philippine bananas and "plátanos" have been numbered and placed in the trial grounds for study:

Agotay.	Balangun.	Binaoy.
Alinsanag.	Banegas.	Binasaya.
Amas.	Bangaan.	Binato.
Angao.	Bangalan.	Binuli.
Asluman or Latundan.	Binangay.	Bocnec.



Standard arrangement, "Cariñosa" banana; showing a typical "hand" and the cross and longitudinal sections of fruit.



Banana roots, showing proper method of packing; received from Porto Rico (seven weeks in transit) in good condition.

Bongoyan.
Bongoyan de dos Racimos.
Boracho.
Bugtong.
Bululan.
Bungan.
Bungolong.
Bungulun.
But-uhan.
Cababa.
Calailay.
Calalay.
Calitan.
Canara.
Canaya.
Candaba.
Canipa.
Cantong.
Carandan.
Carao.
Cardava.
Cariñosa.
Carnaba.
Catep.
Colicot.
Consing.
Cuposa.
Daliao.
Daliring-guinoo.
Darian.
Doca.
Dojoy.
Dool.
Dulol.
Eda-an.
Enetlog.
Enosa.
Famotien.
Finipita.
Fob-olo señora.
Galamay señora.
Galayan.
Gapis.
Ginaring.
Gouyod.
Guinauit.
Gulian.
Guyod.
Guyud.
Higos.
Igos.
Inabaniko.
Inambac.
Inatip.
Ipod.
Inog-og.
Kaalii.
Kadisnom.
Kanala.
Kilan palna.
Kinamay dalaga.
Kinaoit.
Kinayagan.
Lacatan.
Lapnao.
Latundan.
Latundan, or Asluman.
Lawit.
Lisohan.
Litondon.
Longsing.
Maching.
Malbaga, or Manubaga.
Mangamas.
Masecampo.
Matabia.
Maybay.
Mayoco.
Moco.
Morado.
Mundo.
Naglihim.
Pagoja.
Palapaynon.
Pamoti-on.
Panono.
Paquel.
Pelipita.
Pinaghabilinan.
Pitogo.
Plátano.
Plátano (large).
Plátano (small).
Poriquit.
Principe.
Putian.
Raines-na-pula.
Raines-na-puti.
Retundol.
Sabá.
Saba Iloco.
Sabang-Castila.
Saba-Obispo.
Saksik.
Saba-Mariana.
Salebaguio.
Silangan.
Siñangil.
Soybaguio.
Sulay Baguio.
Taisok.
Talipa.
Tampihan.
Tanbunan.
Tancoñgon.
Tarusari.
Taub.
Tenombaga.
Tinalisay.
Tindoc.
Tinombaga.
Todoc.
Tomoc.
Tucon.
Tudlo-dalaga.
Tudlug-dato.
Tumbaga.
Tumoc.
Tundan.
Tundoc.
Tunsing.
Veinticohol.
Virgen.
Unidentified (11).

There are unquestionably a considerable number of synonyms in the above 159 "numbers," but until the plants have fruited in the side-by-side trying-out field the Bureau does not feel warranted in "cutting out" any of the above names. However, information is solicited from planters throughout the Philippines regarding the identity of certain names, and it is hoped much

good will result if free criticisms of this list are handed in to the Bureau. For instance, if practically all of the criticising Filipino farmers should assure us that Sulay Baguio (Leyte name) is identical with Salebaguio (Oriental Negros name), we shall be able to "kill" one of the numbers on our cards; while if some observant planter can assure us that the Malbaga (Cebu name) is not quite the same as the Manubaga, we will endeavor to prove his statement by fruiting a plant or two of each variety in close proximity.

The following 22 supposedly distinct botanical species of *Musa* have been assembled for a comparative test.

M. alba indica.
M. arnoldi.
M. corniculata.
M. chinensis.
M. gilleti.
M. hybrida.
M. japonica.
M. livistoniana.
M. livingstonia vera.
M. martini.
M. superba.
M. ensete.
M. manni.
M. rosacea.
M. sapientum.
M. sapientum var.
M. ornata rosea.
M. rhodoclamys.
M. religiosa.
M. sumatrana.
M. cocinnea.
M. Cavendishii.

The above list could undoubtedly be greatly increased, but since space for the banana tests is already in danger of being overcrowded, the scientific side of this question must be given second place.

While exchange of economic plant material between the Bureau and foreign stations has not proceeded so far as it should have, the following 95 economic varieties have been brought in from outside, and it is believed that nearly all of these sorts will prove to be distinct from those indigenous to the Philippines.

Australia:
- Barrego.
- Butter.
- Delena.
- Moku.
- New Guinea sugar.

Federated Malay States:
- Changi Putri.
- Manka.

Ogasawara Islands (Japan):
- Champa.
- Unidentified (2).

Hawaii:
- Aeae.
- Brazilian.
- Eleele.

Hawaii—Continued.
- Hamakua.
- Hua Moa.
- Iholena.
- Maia Maoti.
- Manaiula.
- Popoulu.

Hongkong: Coolie.

India:
- Boodu Bale.
- Champa.
- Chatim.
- China Champa.
- China Champa (small).
- De Moira.
- Hazara.

India—Continued.
- Kabuli.
- Kanaibansi.
- Kanchkela.
- Karanjalee.
- Kari Bale.
- Katali.
- Lal Velchi.
- Maduranga.
- Martaban.
- Martaban Dacca.
- Mhaskel.
- Moulmein.
- Muthali S. Kaukan.
- Pacha Bale.
- Ramkela.
- Rasa Bale.
- Singapur.
- Sughanda Bale.
- Yale Bale.

Porto Rico:
- Guaran.
- Hardong.
- Kongo Blanco.
- Kongo Colorado.
- Lady Finger.
- Manzana de Cuba.
- Prieto.
- Rosa.
- [illegible]es Cientos.

British North Borneo:
- [illegible]i.
- [illegible]ang Lallang.

Sarawak:
- Ar[illegible]bun.
- An[illegible]awar.
- Betaun.
- Gala kling.
- Gala ulu.
- Hotel.
- Jernang.
- Madu.
- Masak ijoh.
- Masak terjun buah.
- Mas kling.
- Mas Sarawak.
- Plimbang.
- Rajah malacca.
- Rajah Tambi.
- Sabah besar.
- Sebadat.
- Susu petri.
- Tandok dagang.
- Tembatok.
- Turak petri.

Formosa: Funcho.

Saigon:
- Chuô'i già.
- Chuô'i su'.
- Chuô'i lu'a.
- Banane mignonne.
- Banane Gabou.
- Banane Valéry.
- Banane Malgache.
- Chuô'i lá.

Java: Pisang radja.
- Pisang lampenang.
- Pisang ambon.
- Pisang Radja sereh.
- Pisang gembor.
- Pisang mas.
- Pisang Radja siam.
- Pisang Radja tandock.

Considering the very slight expense occasioned thus far in assembling the above 276 varieties of bananas and plantains, and also the fact that it should be quite easy to increase this list during the current fiscal year, we feel much encouraged in this supposedly difficult task of getting accurate information regarding the commercial and technical branches of the banana subject in the Philippines. At present there is probably no one feature of Philippine horticulture, considered both from the Filipino farmer's and the exporter's standpoints, that makes for such splendid success along either home-comfort or financial business lines as does this increasingly popular matter.

A TWO-MAN PRESS FOR MAIZE-LEAF FODDER.

By SAM H. SHERARD, *Superintendent, Iloilo Demonstration Station.*

Much has been said and written regarding the question of the local production of forage. That different kinds of forage will grow and make good hay has been demonstrated by the Bureau of Agriculture, but the problem of interesting the Filipino farmers in this industry is another proposition.

In order to interest local farmers in forage production, the writer believes that two things must be done: First, a steady market for the product must be obtained; second, a method must be found whereby this forage can be put into the smallest possible bulk or package for transportation purposes. It is with the second proposition that this article deals.

At the Iloilo demonstration station the writer has constructed a press that has given very good satisfaction with pea-vine hay and maize-leaf fodder. It is made of lumber, and is 60 centimeters square by 120 centimeters high (2 by 2 by 4 feet). There are eight pieces in the press, as follows: Four sides, two closed and two open; two end blocks, one of which is attached to a lever 10 by 12 centimeters and 4 meters long; and two bands, one at each end.

Two Filipinos can make a 50-kilo bale of maize-leaf fodder in five minutes. The length of the lever has a great deal to do with the amount of pressure, and consequently with the weight of the bale. Rattan is used as the tying material.

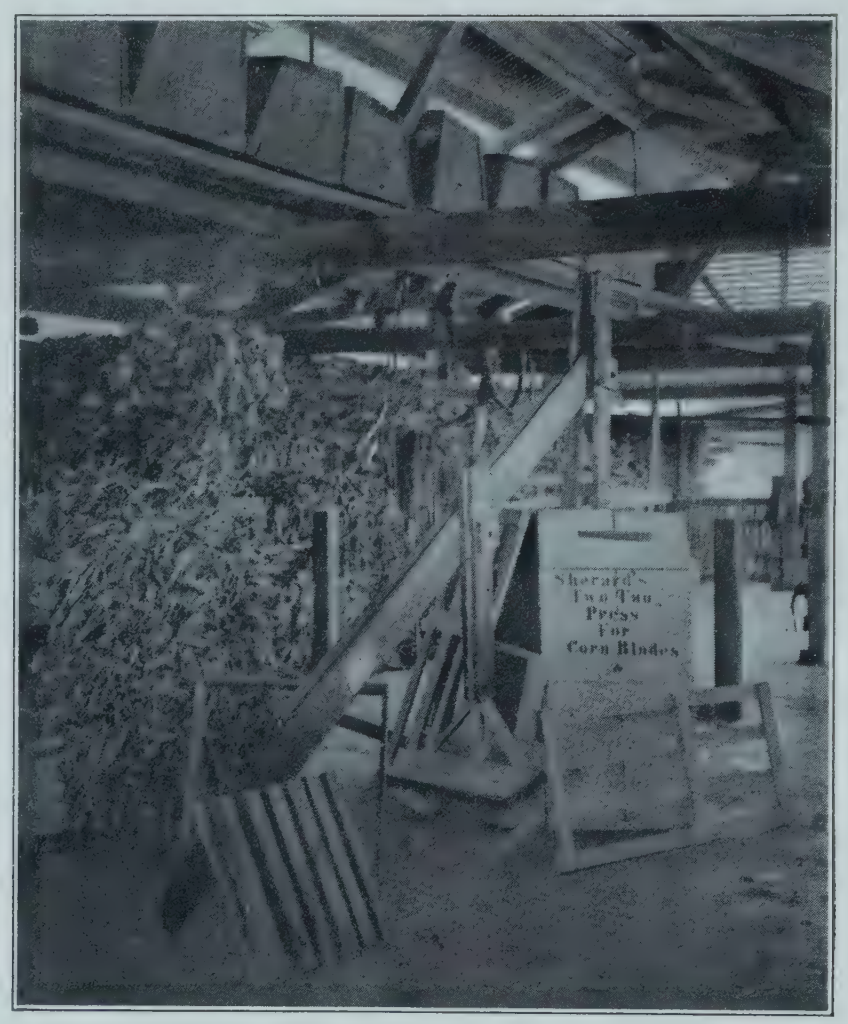
HOW TO MAKE A BALE OF MAIZE-LEAF FODDER.

The press is assembled, and three pieces of 2-meter rattan are placed along the open sides and over the tail block; a Filipino gets inside of the press; the fodder is given to him and he places it in the bottom of the press upon the rattan and packs it down with his feet until the press is half full; he then gets out, more fodder is added and the packing is done with the lever and the upper or head block. The lever is held down tightly while the rattan is being tied around the upper end of the bale. The lever is now loosened, the upper band is taken off, and the sides are taken out from the bottom band, leaving the bale of fodder standing endwise on the tail block.

This press can be made by anyone handy with carpenter's tools, and will cost less than ₱5.



(*a*) Two-man press for maize-leaf fodder.



(*b*) Two-man press for maize-leaf fodder.

SHALLOW VS. DEEP PLOWING IN MAIZE CULTURE.

By H. O. JACOBSON, *Agricultural Inspector.*

The most noticeable fault to be found with agricultural practices in the Philippines is that of extreme shallow plowing. This is particularly true in the preparation of the soil for maize.

Rarely is the soil plowed to the depth of 10 centimeters, yet this is barely half of the depth which is considered good practice by maize growers in the United States.

The fields which have been in cultivation for a number of years have been plowed at a uniform depth scores of times. The top soil, by reason of much manipulation, the action of heat and rain, the retention of roots, etc., has become of a very different composition and character than the soil underneath. It is true that there is a difference in the virgin soil, but this difference becomes more marked under cultivation.

Underneath this layer of surface soil is the furrow bottom, which, being continually tramped and compacted by the feet of the animals drawing the plow, forms a hard crust, especially in clay soils, that resembles hardpan, which practically prevents the passage of either water or the roots of plants.

The formation of this crust, or "plow sole," is further augmented by the sliding and compressing action of the plow bottom and by the settling of fine soil particles when the surface soil is saturated, which clog the pores or small openings that remain.

In our systems of farming, no crops are grown having thick, stiff tap roots capable of penetrating this "plow sole" and remedying this condition, so that eventually a crop growing in the field has its root system confined to this shallow layer of soil.

The purpose of plowing is to loosen the soil, thus increasing its water-holding capacity, allow more air to enter, and enable the roots to pass easily through it.

As a perfect host for the plant the particles of soil must have a film of water surrounding them, but there must not be so much

water that the spaces between the particles are also filled, thus excluding the air.

It is evident, therefore, that this shallow layer of soil underlaid with this impervious "plow sole" will, during rainfall, become so saturated with water that air is excluded; as there is no opportunity for the water to pass downward it must either be evaporated by the heat of the sun or slowly seep to the lowest part of the field.

It is thus easily seen that a given area of soil only 10 centimeters deep can retain only a limited amount of water, and that as soon as all the spaces are filled the remaining water will run off the surface.

When this occurs we meet with a very serious problem in agricultural practice—erosion.

When heavy rains occur this upper layer of soil becomes saturated, the surplus water runs off on the surface carrying with it the fine, rich particles of soil, not only to the lower parts of the field, but also into the streams, into lakes, and into the sea.

This soil containing available plant food is permanently lost and must be replaced. Furthermore, the run-off of water makes ditches and gullies in the field which steadily increase in size, ultimately making further cultivation of the field impossible.

Since it is the plowed or cultivated layer of soil that contains the greatest amount of available plant food, it also is true that shallow plowing necessarily limits the amount of plant food that the growing crop can secure for itself.

It is also true that in this shallow depth of cultivated soil there is actually lack of room for the expansion of the root systems.

Let us assume that we have planted a crop of maize on this shallowly plowed field. A heavy rain occurs, and there being no escape for the surplus water downward, it runs off on the surface and causes erosion. A considerable period of time must now elapse before the remaining surplus water has seeped away or evaporated so that the roots may again assume their normal functions.

The root system, confined mainly to the first 10 centimeters of soil, makes it practically impossible to cultivate without doing great injury to the roots. Cultivating at the shallowest practicable depth of 6 centimeters leaves only 4 centimeters in which the roots are safe; but since cultivation in heavy soils is often given at a greater depth the injury may become serious. If a period of drought sets in the moisture is rapidly exhausted, and the soil temperature increases to such an extent that the

uppermost part of the root system is greatly injured or actually killed by the heat.

It is an accepted fact that the roots of plants tend to go deeper in warm climates than in those which are cool, if conditions are favorable.

Prof. F. H. King, of Wisconsin, found that when maize plants were 76 centimeters high the root system occupied the soil to a depth of 61 centimeters in a soil containing a considerable amount of clay. However, there was no "plow sole" encountered.

Since the root system of the maize plant is fine and fibrous, with no tap root capable of penetrating a hardpan or dense "plow sole," it can be imagined what happens when it is confined to only 10 centimeters of depth.

As has been stated before, two or more plowings are given a field before planting. If, instead of a second plowing given at the same shallow depth, a second plow of the type used for subsoiling be used, immediately following the first plow, the soil can be stirred to a depth of 20 centimeters or more without increasing the amount of labor or expense.

A subsoil plow does not turn the furrow over, but by means of the flat upright part, to the bottom of which a wedge-shaped share is attached, the "plow sole" is broken up and the soil is lifted and stirred somewhat and deeper plowing is accomplished without altering the position or relation of the surface soil and the subsoil.

Suddenly increasing the depth of plowing whereby a large amount of inert subsoil is placed on the surface may result disastrously.

The subsoil is exceedingly compact, containing little organic matter, and, of course, not being subjected to the weathering processes, is not so suitable for plant growth as the surface soil. For this reason the depth of plowing must be increased gradually. However, if instead of using a subsoil plow, the farmer chooses to gradually increase the depth of plowing, the desired depth of soil culture may be attained in three years, by increasing the depth of plowing about 3 centimeters each year.

Under present conditions the depth of plowing has been determined almost solely by the draft capacity of one carabao. In the plowing of rice paddies the argument for one animal only may be allowed, but to limit field operations generally to this argument is extremely childish, since the most primitive people everywhere have solved the problem of using two or more draft animals as a unit.

If deeper plowing cannot be accomplished with one carabao, two should be used.

The advantages to be gained by deeper plowing are numerous.

By destroying the "plow sole" and loosening up a greater depth of soil, its water-storage capacity is enormously increased, thereby retaining more available moisture during dry weather and preventing erosion to a considerable extent.

More plant food becomes available, simply because there are more cubic centimeters of soil within reach of the root system, if for no other reason.

Since the bulk of the root system will be deeper by not being confined by the "plow sole," danger of injury by cultivation is largely obviated and there is also less risk of damage due to heat in times of drought.

Very sandy soils, however, should never be plowed deeply.

An illustration of the argument for deeper plowing that will be recognized occurs in nearly every field. For example, where the field is back-furrowed—that is, where the surface soil is turned back upon the unplowed land making a deep surface soil—the growth of maize always is superior to any other portion of the field, while in the "dead furrow," where there is little surface soil, but little growth takes place. This shows that, because of the greater amount of plant food and water available on the "back furrow," greater growth is attained.

Because the term "subsoiling" has been used in this article, it must not be inferred that the practice advocated above is equivalent to subsoiling as practiced in the United States or in Europe. In those countries, subsoiling means stirring the soil to the depth of 50 centimeters or more, while in this instance a method of plowing about 20 centimeters deep is outlined.

The problem of constructing a suitable subsoiling plow can easily be solved by any local mechanic who is able to make the native plow.

AGRICULTURAL CONDITIONS IN THE SUBPROVINCE OF AMBURAYAN.

By AUSTIN M. BURTON, *Agricultural Inspector.*

Amburayan, a subprovince of the Mountain Province, is located on the west-central coast of Luzon between the Provinces of La Union and Ilocos Sur. Tagudin, the capital of the subprovince, is the coast town where the bulk of supplies for the central portion of the Mountain Province are unloaded, to be carried inland over the Tagudin–Cervantes trail by bull cart or pack horse.

The subprovince rises from a narrow coastal plain to an elevation of several thousand feet, consequently the climatic and soil conditions vary greatly, making possible quite a variety of crops.

The principal crop grown is rice, approximately 5,000 hectares being devoted to this purpose; the average harvest is 120,000 cavanes.[1] Both mountain and lowland rice are grown, the latter furnishing about 80 per cent of the crop. The mountain rice is planted on the hillsides after the first rains in May or June and is harvested in October or November. Very little care is taken in preparing the ground, which is merely scratched and the rice broadcasted. The lowland rice is planted in July and August and harvested in December and January. This necessarily receives more care than the mountain rice, it being necessary to plant the lowland variety in seed beds, transplant and irrigate.

Camotes form quite an important item in the diet of the people and about 65,000 cavanes is the estimated production for the province. As the American sweet potato is far superior to the camote grown here, a number of plats have been planted and extensive distribution of cuttings will be made as soon as the plants become large enough for this purpose. Corn is grown in the coastal plain and foothill regions, the crop for last year having been 2,363 cavanes. The corn is not of the best quality

[1] 1 cavan equals 75 liters.

or yield, so in hopes of improving the status of this staple crop, plats of improved varieties are being planted in the different townships. The seed from these improved varieties will be saved and used for more extensive planting next year.

Other crops grown are tobacco, cotton, sugar, and cacao. The yield in 1912 of these crops was as follows: Tobacco, 389 quintales;[1] sugar, 652 piculs;[2] cotton, 84 piculs; and cacao, 3 piculs. A considerable portion of the cane grown is used for the manufacture of basi[3] for home consumption. The cotton is used in the home manufacture, on the old-style hand loom, of cloth, blankets, towels, and similar articles. Most of the clothes worn by the natives are made at home.

There are a number of small fertile valleys in the foothill regions where cacao thrives and there is no apparent reason why each home should not have a number of trees planted. With this end in view a large number of cacao seedlings have been grown in the townships adapted to this crop and the trees are being distributed and planted as soon as they attain suitable size. All seedlings so far grown are in a healthy and thriving condition.

Coconuts are grown to a limited extent and are not particularly vigorous nor prolific, probably due to lack of care more than any other reason.

Few papayas are grown, although those at present seen seem to indicate that the papaya will do well here. Seed beds of papaya have also been started in a number of the townships, the intention being to follow the same plan as mentioned above for cacao.

The live-stock reports for 1912 showed 309 horses, 929 cattle, 6,097 carabaos, and 6,050 hogs in the subprovince. The deaths reported in 1912 as due to disease were 3 horses, 46 carabaos, and 43 hogs. Rinderpest caused the majority of deaths among the carabaos. There is at present no rinderpest in the province, the quarantine having been removed March 4, 1913.

A considerable variety and quantity of hardwood timber of the first group is found in the mountains, but on account of the difficulties of transportation little of it is utilized except locally for building purposes.

The construction of a rather extensive irrigation system is now being given serious consideration. The bulk of the land embraced in this proposed system lies in the coastal plain between

[1] 1 quintal equals 46 kilos. [2] 1 picul equals 63.25 kilos. [3] A native wine.

Tagudin centro and the southern boundary of Ilocos Sur. A preliminary survey showed nearly 6,200 hectares which can be irrigated between a 12-meter contour. This land is divided into a number of small parcels, consequently a number of people would be benefited. That such an irrigation system would be of inestimable value in insuring the rice crop in time of drought is obvious, and the suffering resulting from the short crop of 1911 emphasizes the need of such insurance.

Forty-three kilometers of the Tagudin–Cervantes trail lie in Amburayan subprovince. This is a cart trail and is practically the only outlet from the Mountain Province to the sea, and consequently has to carry a great deal of traffic.

There are as yet no first-class roads in the subprovince, but work is now being done on a stretch of road from Tagudin to the northern boundary of La Union Province. This road is a part of the coast road running through La Union, Amburayan, and the Ilocos Provinces. When this is completed, also a few sections of road farther north which are now being improved, there will be a good road, passable at practically all seasons of the year, running from Aringay, Union, to Laoag, Ilocos Norte.

CURRENT NOTES—SEPTEMBER.

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

AGRICULTURAL CONDITIONS IN OUR NEIGHBOR COUNTRIES.

The first coconut and rubber plantations in Papua are just beginning to yield encouraging returns, according to the Daily Consular and Trade Reports. While the European population of this very interesting new island territory of Australia is not increasing to any great extent and probably never will be large, a great advance has been made along agricultural settlement lines. The total area now planted is only some 10,000 hectares, but this figure is rapidly increasing. Some 65 per cent of the total cultivated area is under coconuts and most of the remainder under rubber, though some sisal and tobacco are in evidence.

In British North Borneo labor difficulties continue as the principal hindrance to agricultural progress. It is now proposed to put into effect "land-grant" settlement regulations by which Chinese planters may secure small farms on easy terms. These settlements will be connected by government cart roads. There are now about 14,000 Chinese, 4,000 Japanese, and only 300 native laborers in evidence, and these are mostly on the few comparatively large estates. Twelve estates are reported as producing tobacco, while only five are cultivating coconuts, one pepper, and one gambia. One "old" rubber plantation is said to be in evidence near Sandakan, and there are probably others in process of development.

AGRICULTURAL PROGRESS OF CURAÇAO.

An ostrich-farming experiment is now under way in this diminutive but rather important West Indian colony of Holland.

Sisal culture is also being given a strong impetus by the present high prices and the government is encouraging the setting out of large numbers of plants from Trinidad and Surinam. The Sisal Culture Company has recently purchased, according to the

Daily Consular and Trade Reports, some half million suckers. From a personal inspection of the land about the capital, Willemstad, the soil would seem to be very well adapted to sisal culture. Only some crop like sisal, which is almost independent of rains, will be suited to the exceedingly long droughts which frequently occur in Curaçao. The drought period which caused so much damage throughout the world in 1912 resulted in the death of many of the animals in Curaçao and most of the crops were, of course, a failure, since for nineteen months there were only some 300 millimeters (12.19 inches) of rainfall.

The jipijapa, or so-called panama-hat, industry, owing to improved methods, is progressing very favorably; the fiber itself is, of course, imported from South America. The writer took some of this fiber to Porto Rico from Willemstad in 1903 and the industry in Porto Rico has gradually assumed considerable proportions, although recent export duties in Colombia, Panama, and Venezuela have greatly reduced the profits to the local dealers and manufacturers. By the way, a considerable number of jipijapa plants are now growing finely at the Lamao experiment station.

NEW GOVERNMENT INSTITUTIONS IN BRAZIL.

Increased interest in agricultural schools, breeding stations, and demonstration farms is evident in this great and wealthy South American country. A new type of agricultural institution is called the "Apprentice School;" here are taught not only thremmatology, but the hygiene and correct feeding of all kinds of domestic animals, as well as the various branches of farm mechanics and agrarian practices. The graduates of these agro-technology schools and the demonstration farms find ready employment in the numerous estates which are being established throughout the cultivable areas of eastern Brazil.

The Government is establishing zoötechnic stations at Pinheiro, Lages, and Riberao Preto. First-class breeding stock—horses, cattle, and pigs—are being imported from Europe and America. Besides these stations two model stud farms have been established.

The veterinary service is now an effective arm of the Government; this regulates the sanitary inspection of all live stock, the distribution of vaccines, the isolation of suspected animals, and, of course, the proper scientific study of the various animal diseases themselves.

BANANAS IN GREAT BRITAIN.

The popularity of the banana as a raw-product food is rapidly increasing in Great Britain. The imports into the British Isles are now about one-half million bunches per month; this is an increase of some 50 per cent over the rate of 1911. The bacterial disease of the banana plant will probably decrease the output of certain districts in Central America, if not in the West Indies; the growing demand in England, however, will help to encourage the planters.

TURTLES.

There is a deplorable scarcity of turtle steaks in Manila. While two or three species of edible sea turtles are to be found occasionally in the markets of this city and probably very frequently in the markets of the southern islands, the supply is very uncertain. There is, however, no better flavored meat in the opinion of many connoisseurs than that of the green or leatherback turtles, provided it is properly "dressed" without the too common admixture of sand in the cuts of meat.

Recently a promising industry has sprung up along the coast of Magdalena Bay and Lower California. Here the natives subsist very largely on turtle flesh and the animals may be obtained in season at about ₱1 each. Those which reach the San Francisco market alive are worth ₱10 on the spot. These turtles weight about 70 kilos, or about the same as those of Manila Bay and vicinity.

BRAZILIAN RUBBER.

During the fiscal year 1912 Brazil exported of the four ordinary grades (fine, medium, coarse, and caucho) 42,859 tons of rubber. This tremendous output is something over 5,000 tons greater than that for the previous fiscal year.

Now that the Hevea plantations of Ceylon and Malaya are turning out so much cultivated rubber, however, the quantity exported from Brazil is not much more than one-half of the total production of the whole world.

THE WORLD'S CACAO PRODUCTION.

Scientific horticulture and careful attention to field methods have seldom shown more striking results than in the case of the Gold Coast cacao industry. In 1910 this country ranked fourth among the world's greatest cacao producers, but it now far excels even Ecuador, which was until 1911 the only rival São

Thomé had for first honors. Bad practices and fungus diseases are surely telling on the São Thomé crop; although extension of area has been going on, the crop of 1912 was considerably less than that for 1910 (36,665 tons).

With very little noise or advertisement, the great new cacao country of the Guinea coast has leaped to first rank and will probably hold this place for many years to come. In 1910 only some 23,000 tons were produced; the 1911 crop was nearly double this.

Southern Nigeria, a near neighbor of the Gold Coast, is rapidly developing the cacao industry, the crop for 1911 being an increase of nearly 50 per cent over 1910. Brazil, as was expected when she began her cacao planting some ten years ago, has forged to the front and now ranks as fourth in the 1912 list.

Trinidad, British West Indies, has been suffering for some ten years with a combination of bad cultural practices, absurd overshading, and a very severe fungus disease. The production for 1910 was over 26,000 tons, but for 1912 was less than 19,000 tons.

According to the Gordian of Hamburg, the total production of the world is at present about 230,000 tons, worth, in bulk, about 150 million pesos.

BANANAS IN JAMAICA.

While authorities, especially commercial people, differ, the writer fully agrees with W. Harris, esq., superintendent of public gardens, Kingston, Jamaica, when he states:[1]

> The bananas used locally are very superior in quality to those consumed abroad, because they are allowed to fully mature and get partly ripe before they are gathered.

Most people unfortunately never get an opportunity, outside of the Tropics at least, of eating a banana which has been ripened on the plant. Furthermore, even in the Tropics, the banana or plantain ripening on the stem is very seldom seen outside of large estates where these fruits are grown in a haphazard way or left to actually "run wild." The reason for these fruits seldom being allowed to ripen on the stem is a very deplorable one; petty thievery, or, as the British planters term it, predial larceny, is ubiquitously common right around the world. The owner of the plant, fearing he will not reap the reward of his labors (supposing, of course, he *has* labored with the plant), is virtually compelled to harvest the bunch a little before it is

[1] The Jamaica Department of Agriculture Bulletin, vol. 2, No. 6.

fully mature. This fact may not seem of any great importance in itself, but it really has kept back the due popularity of bananas as *a food for the millions to a great extent.* Certain varieties are almost poisonous when consumed in a raw state unless the fruits have been ripened on the plant; their pecten is turned to starch and sugar only by cooking or by the fruits' becoming fully developed and then "yellowed" on the plant.

There are now some 17 million bunches of the Gros Michel, Jamaica, or Martinique variety exported from Jamaica each year. The value of this tremendous bulk of fruit is about 15 million pesos. This vast crop, however, is raised on less than 40,000 hectares of land.

The demand for banana "figs," or dried ripe bananas, is steadily increasing in Jamaica and several factories are busy trying to fill their orders.

Mr. Harris gives several new recipes for banana puddings and tarts, among the most interesting of which are the following:

BANANA PUDDING, BAKED.

Four ounces bread crumbs, 4 bananas, 2 eggs, 1 pint milk, 4 tablespoonfuls sugar, nutmeg, rosewater (or other flavoring).

Peel and mash the bananas and add to them 2 tablespoonfuls of sugar and a "squeeze" of lime juice, adding nutmeg and rosewater. Place this preparation in the bottom of a well-buttered pie dish. Put the bread crumbs over this. Make a custard with 2 beaten eggs, a pint of milk, and 2 tablespoonfuls of sugar; pour over the whole and bake until a nice brown color.

PLANTAIN (PLÁTANO, OR TINDUK) TARTS.

Take ripe plantains, boil them, and allow them to cool. Sweeten and add spice to taste. Place on thin pastry, fold, and bake.

This "filler" may be colored with any of the vegetable color compounds or, still better, mixed with roselle marmalade.

One point the housekeeper should remember in cooking bananas is that a little lemon juice or juice of the calamondin or lime will "bring out" the true flavor of these fruits and prevent the so-called "mawkish" taste which certain bananas may have unless thoroughly ripe before cooking.

A NEW CULTIVATOR.

In La Vie Agricole, a French journal of modern agriculture, we find illustrated and described a wonderful invention embodying the pneumatic tool with a farm motor vehicle. This vehicle, propelled, of course, by gasoline, is adapted for cultivating crops such as sugar beets, maize, beans, etc. The body of the motor

straddles two or three rows of plants and cultivates four rows at one passage. Three pneumatic tubes extending from the air pump apparatus in the front of the motor are connected with hoes or similar weed-cutting tools, each tool being guided by a laborer walking in front of the machine. The pneumatic apparatus working the hoe itself is supported on a small wheel to which is attached the guiding handle in the hands of the laborer. The frequency of the blows delivered by the hoes is, of course, regulated to suit the ground and plants.

Thus, as fast as the laborers can walk and direct the hoes the ground is pulverized, ventilated, and freed from weeds. Another laborer walking behind the motor attends to the hilling-up attachments that shift the loosened earth toward or away from the four rows of plants under attention. Such a machine is, of course, rather expensive and to be used only on large level fields; but in a country where animals are expensive, such an apparatus will undoubtedly be a valuable addition to the future agriculturist's set of farm machines. One of these machines with the four laborers and chauffeur is calculated to do the work of 35 men.

THE WORLD'S CATTLE.

It is not generally known that there is one tropical country which produces so many cattle that the famous Argentine and even the United States are put "hopelessly in the shade" by comparison. Whereas Argentina boasts of about 30 million head and the United States of about 60 million, British India has now, according to late estimates, over 120 million head of kine (probably including carabao). Strictly speaking, it is hardly fair to call the Indian zebus cattle, any more than the banteng of Java and the middle East Indies are true cattle, since they belong, of course, to another zoölogical species.

Another strange feature about the tremendous figure of the cattle, or rather *zebu,* census of British India is the fact that very little of the stock-raising business depends upon the demand for *meat,* since no Hindu uses beef in any form and the Mohammedans use very little. In a country more or less troubled with surra, rinderpest, and other severe animal diseases, this fact of India's possessing more head of "neat" stock than the two next greatest stock-raising countries, i. e., the United States and European Russia (with 37 million head), is as difficult to understand as is the fact that India far excels all other countries except the United States in tobacco production—225,000 tons per annum

in a country where smoking is apparently rare and exports of either raw or manufactured product are very low.

Switzerland, with all her world-wide reputation as the country that feeds the world with tinned milk, has only a paltry million and a half head of cattle. Denmark ranks as the country possessing the most cattle per capita—nearly one head for each inhabitant.

DASHEEN.

This comparatively new vegetable, closely resembling the Philippine gabi, a variety of *Colocasia antiquorum,* is now attracting considerable attention in the southern districts of the United States. A circular on this new root crop has just been issued by Mr. R. A. Young, of the Bureau of Plant Industry, Department of Agriculture, Washington, D. C.; this pamphlet gives full cultural directions and an excellent set of recipes for serving the tubers.

Besides the ordinary methods of cooking the starchy content of the root, which, by the way, is much better flavored than the ordinary gabi, a new idea has been brought out—the forcing of ripe tubers and rootstocks with the object of using their asparaguslike shoots as a salad vegetable. The young leaves of the growing plant may also be boiled and used as a spinach, or "gulay." Strangely enough, several of the best new varieties of dasheen have been introduced during the past few years from Japan. The writer introduced this vegetable into Porto Rico and the United States from Trinidad in 1903.

The word is a corruption of the patois phrase for either *des Indes* or *de la Chine,* this vegetable in Trinidad evidently having been supposed to be an oriental crop.

Several of the best new dasheen varieties are now under propagation at the Singalong experiment station.

AVOCADOS.

A recent shipment of bud wood of 48 varieties of this very important fruit having just been received from the United States Department of Agriculture, Washington, D. C., the question of the future popularity of the avocado is again brought to the surface. The fact, however, that most of the old seedlings from Hawaiian fruits have now proved themselves and give fair assurance of their adaptability to Philippine climatic conditions, there seems no longer any good reason why one interested in first-class high-priced fruits for the market should not give special attention to the planting of the avocado. A tree about

8 years old in Manila has just finished ripening over 300 fruits of first-grade size and flavor. The old seedling trees at the Lamao experiment station, which were severely infested with insect pests a few years ago, have recovered and several have borne a fair crop this season.

In passing, it must be remembered that although few varieties are ever seen on the wholesale market, there are in reality no less than 60 or more recognized kinds of this fruit. Of these there are some three or four types or groups: For instance, the thick-skinned varieties of Guatemala and Honduras would hardly be considered by the casual observer as related to some of the almost skinless Mexican sorts. Again, some of the shining black Central American varieties would hardly be classed with the red, yellow, and green sorts of Venezuela, Cuba, and Porto Rico. The shapes vary from round to long-necked forms; and the sizes run from, say, 50 grams to 1 kilo.

A promising new variety has just been discovered in Venezuela and another has been sent in to Washington by a collector in Chile. From central Chile to southern California and from Panama to Barbados there are very interesting possibilities in this line, speaking both commercially and scientifically, and the next decade will probably see a great deal of work done in avocado crossbreeding and selection. Orchardists in southern Florida are already beginning to plant out seedlings with the idea of saving those which stand the fruiting test, giving them names just as seedling oranges, pomelos, and apples are named and thereafter propagated by buddage; most of the Florida as well as the California avocados are budded nowadays, i. e., they are *named* varieties, on a par with the named citrus fruits.

One feature of avocado growing not to be neglected here is the selection of varieties that will fruit during the dry season. This would avoid possible loss of fruit through injury by wind and rain.

Another thing which will tend to make the avocado one of the few really important fruits of the future is the very high nutritive value of the pulp; this contains from 15 to 18 per cent of readily digestible oil besides a fair percentage of starch and sugar. In fact, the avocado is one of the few fruits which would serve as an emergency ration without any other food for a considerable time. The reputed aphrodisiac qualities of the pulp are probably quite nonexistent. The comparatively high price of the fruit on the retail market, depending largely upon the supply, of course, is almost entirely responsible for the slow progress of this fruit toward world-wide popularity.

NOTES BY P. J. WESTER, Horticulturist.

NEW FORAGE PLANTS FOR THE PHILIPPINES.

Less than twenty years ago the Florida velvet bean, *Stizolobium deeringianum,* was cultivated merely for its ornamental value, and its great value as a forage and a cover-crop plant was just beginning to be appreciated. The history of the Lyon bean, *Stizolobium lyonii,* as an economic plant is limited to less than a decade, and it has just become well introduced into the United States. Both these species are extremely valuable legumes in the Tropics and subtropics, notwithstanding which, relatively speaking, both have their faults. For instance, both have a long season of growth, which in a subtropical climate is objectionable in that the vines are frequently frozen before the seeds mature. A good seed producer, yet the velvet bean is inferior in this respect to the Lyon bean. The Lyon bean, on the other hand, has been accused of shelling its early matured beans in the field before all have ripened. In order to combine the good qualities of each species, Mr. John Belling, assistant botanist of the Florida Agricultural Experiment Station, Gainesville, Fla., some two or three years ago hybridized them and as a result obtained a large number of hybrids. Most were, as is usual in such cases, of no value agriculturally, but several were found to be distinct improvements.

Mr. Belling some time ago sent the Bureau of Agriculture seeds of several of his most promising hybrids and also a considerable quantity of seeds produced by hybridizing the two aforesaid species. The seeds have been sown at the Lamao experiment station, and the plants are making good progress. From the present outlook the Philippines, through these hybrids, will gain a number of new and distinctly valuable forage and cover-crop plants.

One of the prominent forage grasses of India is *Pennisetum cenchroides,* a grass of rapid and luxuriant growth, to which the attention of the writer was first called in south Florida, where it had been accidentally introduced, probably in fertilizer or packing material. After considerable correspondence seeds were obtained from Ceylon some time ago from which a small plat is now establishing itself. It is to be hoped that this new introduction may be more successful than several grass introductions of the past, notably the Teff, *Eragrostis abyssinica,* and Natal grass, *Tricholæna rosea,* which were introduced within the last two years, both of which failed to maintain themselves, and the Australian river grass, which is too unproductive and of

too undesirable a habit to be worthy of cultivation. Of those that have been tested guinea grass is by far the best yet introduced for green forage and Rhodes grass the best for hay. Though of fair growth, we fail to perceive any growing enthusiasm for the molasses grass which was introduced two years ago.

NEW SOURCES OF PAPER.

As the population of the earth increases and the needs of humanity multiply, and the inhabitants of the Temperate Zone discover that after all the habitability of the equatorial belt, with its large area and with its enormous agricultural possibilities, is a question of sanitation and right living, at a correspondingly rapid pace will man invade the Tropics in search of these needs that the overpopulated, and from the viewpoint of agricultural production, the "slow," Temperate Zone fails to supply. One of these wants is paper, and for quite a number of years a common topic of discussion in technical as well as popular publications has been the approaching paper famine. While the pine forests of the Temperate Zone were the principal source of supply for a demand that was increasing by leaps and bounds it did indeed appear serious to the pessimist devoid of imagination, and who did not think of the Tropics, where things grow while one waits, so to speak.

Not so long ago the Philippine Bureau of Science announced that the requirements for the manufacture of paper from bamboo had been worked out by a member of the scientific staff of the Bureau, and a well-written paper on the subject was published by the same Bureau and the matter is still fresh in the minds of the well informed. In the meantime another source of paper has been discovered that opens up new possibilities in tropical agriculture as noted in the agricultural bulletin of the Federated Malay States.

The February issue of this, our valuable contemporary, contains an article quoted from the Kew Bulletin on the utilization of certain *Zingiberaceous* plants for paper manufacture that is of great interest to the Philippines, considering that the most promising of the plants discussed, *Hedychium coronarium* Koenig., grows wild in the Archipelago, not to speak of the numerous related species the value of which has never been investigated, and which luxuriate in most parts of the Archipelago.

It appears that the paper-making qualities of *Hedychium coronarium* are equally good whether the fiber is produced from the green material or the dried plant, a great advantage both from

the growers' and the manufacturers' point of view. We quote the following:

> Papers produced from this fiber (made from *Hedychium coronarium*) have even greater tensile strength than the strongest Manila papers produced. * * * Its elasticity and folding qualities are exceptional. Moreover, it can be made to bear ink and possesses parchment qualities without any sizing or other special treatment. The reason for this we find to be due to the presence of the cells associated with the fiber, which are of a semigelatinous nature when chemically treated, and dry into the interstices of the paper and produce natural parchment. * * * The pitch cells, which can be retained or not, according to requirements, possess very peculiar qualities. If taken alone, the unbleached cells when dried go down to a horny mass, which can only be broken with very great difficulty with a hammer, and are softened only with difficulty when boiled in soda. If retained in the paper, they give it parchmentlike properties to an extraordinary degree. They also render the paper ink bearing without the addition of any sizing material. * * * On the other hand, paper made from *Hedychium* from which the cells are removed is of a soft nature and of medium strength, but that in which the cells are retained * * * gives higher "breaking lengths" than any manila paper that we have so far had the opportunity of examining. The oval cells, therefore, "parchmentize," strengthen, and size the sheet. * * * We draw attention to this fiber, as we believe it may become of great industrial importance to the paper trade. Where circumstances are congenial to its growth, the plant spreads to the exclusion of all other vegetable growth by means of its rhizomes, so that it can be harvested at least once a year, producing a heavy crop. It is an easy pulp to manipulate. It is capable of producing a paper of exceptional strength and can be worked either bleached or unbleached. The fact that the paper in its natural state, without the addition of any material whatever, can be made to possess grease-proof and self-sizing qualities is a point of commercial importance.
>
> * * * The tensile strength tests indicate that the fiber from the green stem is almost exactly similar in strength to the best pure manila binder twine.

In conjunction with the investigations of *Hedychium coronarium,* which were made in London, England, tests were also made of two other related species, *Amomum hemisphericum* and *Alpinia nutans,* both indigenous to the eastern Tropics. The paper produced from these species is of good quality, although they do not possess the extraordinary paper-making qualities of *Hedychium coronarium.*

The natural habitat of *Hedychium coronarium* and related plants is low, moist, rich land in swampy situations, along streams and rivers. All are of easy and vigorous growth and well able to hold their own against other vegetation once they are well established, and they are readily multiplied and propagated by the division of their underground rhizomes. The stems of *Hedy-*

chium coronarium reach a height of from 1.5 to 2 meters and are 2 to 4 centimeters in diameter. The plant requires a period of four to five months to attain its full growth between each cutting. The stems of *Alpinia nutans* and *Amomum hemisphericum* attain a height of about 3 to 4.75 meters, respectively, and several of our Philippine *Zingiberaceous* plants, which *might* be equally valuable as a source of paper, are also equally vigorous in growth.

We should like to see some one investigate this possible source of revenue to the Philippines.

NOTES BY M. M. SALEEBY, Chief, Fiber Division.

MARKETING OF PHILIPPINE KAPOK.

In establishing a new line of trade, in any country, especially with respect to a commodity well known in other countries, great precautions must be taken to obtain a reputation in that particular line. The infancy of any industry is its most delicate stage, and an improper start invariably results in an undue delay in its successful establishment or in its speedy death. A false impression can be easily and speedily created, but a rectification of this may take many years at the cost of considerable trouble and expense.

The production of Philippine kapok as an article of export is comparatively recent, and the industry may justly be considered as in its infancy. This, therefore, means that the product should be so prepared and marketed as to attract the attention of the consuming markets and compare favorably with the product of other countries. The establishment of a favorable reputation for Philippine kapok should, therefore, be the prime object of all parties interested in its production and export. This timely notice is prompted by the receipt of communications from kapok consumers in the United States and Australasia to the effect that Philippine kapok reaches them in a semicleaned state. Next to Holland, these markets are the most important with respect to kapok, and it is principally to them that the Philippines should look for the sale of its product.

Several kapok plantations have recently been established in the Philippines, and it is hoped that more will be established in the near future. In the course of a few years considerably more quantities of floss than at present are expected to be placed on the market, and in order to increase the production of kapok and develop the industry to the extent to which it is entitled, it is of the utmost importance that all exporters should take the necessary precautions, more particularly at this stage, to supply the

markets with the product in exactly the quality and condition necessary. Machines for cleaning the seed are now available, and they should be secured for use, even though the present quantities of kapok entering the market are not sufficient to warrant their continual use. Careful baling and durable and proper wrapping of the bales are both necessary. Philippine kapok, when carefully cleaned, compares favorably with the kapok of any other country, and the demand for it is bound to increase as long as its qualities remain unimpaired.

PRODUCTION AND PRICES OF ABACÁ (MANILA HEMP) DURING FISCAL YEAR 1913.

Whenever a prolonged drought or a severe typhoon occurs in any of the principal abacá provinces of the Philippines, an undue and unwarranted confusion of the local and foreign markets usually follows. Such a confusion can be accounted for by false rumors, by hurried and inaccurate reports, and by the actions of certain buyers or brokers of influence. As a result of these causes prices fluctuate abnormally and without sufficient justification, leading in turn to irregularities in the supply of fiber. These invariably afford opportunities for speculation on the part of the brokers, and the markets ordinarily remain in an unsettled condition for a year or two. Such has been the status of the abacá industry since the drought of 1912, and it will probably take another year before conditions become normal again.

In order to prevent the occurrence in the future of any such confusion in the local and foreign fiber markets, it will be necessary that these markets should be adequately acquainted as soon as possible with the actual condition of the industry subsequent to the occurrence of a drought or typhoon. With this end in view this Government, through the Bureau of Agriculture, is now prepared to inaugurate a quick service whenever similar occasions arise in the future. The best interests of the producers and the manufacturers require that the market be steady and that, if a fluctuation occurs one way or the other, it should be in response to the law of supply and demand.

The fluctuations in production and prices of abacá since July, 1912, bear a significance to all parties interested in the industry. These data, in connection with the same data for the fiscal year 1914 (July 1, 1913, to June 30, 1914), will form a complete record which will undoubtedly help considerably to forecast the trend of the industry, should the same or a similar calamity to the abacá crop occur in the future.

The actual production of abacá during the past fiscal year (1913) will not be known for a few months yet, but the exports during the same year amounted to 144,576 metric tons, valued at ₱46,089,488, or a decrease of 9,471 metric tons in quantity and an increase of ₱13,522,468 in value over the exports during the fiscal year 1912. The following tables give the receipts of abacá at all shipping ports in the Philippines since July 1, 1912, together with the fluctuations in prices during the same period. Table No. 1 is compiled from the weekly reports of the Manila Chamber of Commerce and Table No. 2 from the daily quotations in the Manila market. Similar figures will also be compiled for the fiscal year 1914, at the end of which it is believed the market will again be normal.

TABLE NO. 1.—*Receipts of abacá at all ports from July, 1911, to June, 1913, inclusive.*

Month.	Fiscal year 1912.	Fiscal year 1913.
	Bales.	*Bales.*
July	71,197	123,528
August	87,176	109,989
September	96,458	120,082
October	113,428	104,708
November	84,605	98,128
December	134,331	118,591
January	119,882	87,386
February	96,378	89,198
March	101,051	100,212
April	123,304	60,886
May	123,580	71,910
June	136,685	74,818
Total	1,288,125	1,159,436

NOTE.—One bale weighs about 125 kilos (275 pounds), thus giving approximately 8 bales to the metric ton.

TABLE NO. 2.—*Fluctuations in the prices of abacá in the Manila market from July, 1912, to June, 1913.*

[Prices in centavos per kilo.]

Month.	Good current.	Midway.	Current U. S.	Superior seconds.
1912.				
July	27½ to 38½	25⅓ to 34¾	19¼ to 27	11⅕ to 14¾
August	36⅓ to 39½	33¼ to 35½	25⅓ to 27½	14¾ to 15¾
September	39½ to 42½	35½ to 38½	26¾ to 28½	15¾ to 17⅓
October	42¾ to 45¾	38 to 41	28½ to 30	17¾ to 22¾
November	47½ to 50½	42¾ to 45¾	30 to 32¼	19½ to 23½
December	50½ to 52	45¾ to 47½	32 to 34¾	21 to 23½
1913.				
January	52 to 53½	47½ to 49	33¾ to 36½	22½ to 24
February	48 to 52	41 to 47½	30 to 33¾	20½ to 22
March	48 to 48	41 to 41	28 to 30	20 to 22
April	44 to 47	37 to 41	26 to 28	20 to 21
May	41 to 44	36 to 37	26 to 27	20 to 21
June	39 to 41	34 to 36	23 to 26	18 to 19

SCARCITY IN PRODUCTION OF HIGHER GRADES OF ABACÁ—ITS CAUSES AND REMEDIES.

During the last six or eight years there has been a scarcity in the production of the grades of abacá, including good current and better; but since the 1912 drought this scarcity has become more evident than perhaps at any other time prior to the occurrence of this drought. When we consider the fact that the value of these high grades has during the last year or so proportionately risen much higher than that of the lower grades, and the further fact that the demand for the former has been and is still far in excess of the supply, we cannot but feel the utmost surprise and disappointment because the producers do not respond to the requirements of the market, which in this case happen to be in direct accord with their best interests. It is its admirable qualities in the higher grades that have given abacá an undisputed rank as the premier cordage fiber of the world, and therefore any reduction in the production of these grades is bound to injure its reputation and consequently strengthen the position of all competing fibers.

The present scarcity in the higher grades of abacá is due to several causes, chief among which may be mentioned the following: First, insufficient discrimination in prices on the part of the majority of the local provincial buyers, which is encouraged by the economical dependence of the majority of producers on the buyers who are also either merchants or money lenders, or both; second, lack of control over the laboring class (strippers) on the part of most of the producers; and third, to the rise in the prices of the fiber, which in turn is chiefly caused by a shortage in production. This last appears to be a paradox, but, peculiar as it sounds, it is nevertheless true. The only explanation that can be made of such peculiar conduct on the part of the small producer, who supplies the larger part of the crop, lies in the fact that as long as the proceeds from the farm satisfy his immediate necessities of life he is usually content, and not prone to push his interests beyond that limit. In other words, as long as he can make a living with comparatively easy work, the small producer is not, as a rule, inclined to work harder and make money which he does not immediately need.

A careful analysis of the present situation will at once show that the remedy lies chiefly in the institution of either or both of the following agencies, planters' coöperative associations and local agricultural banks. The first must originate among the

progressive class of producers in each town or district, not only for the protection of themselves but also for that of the uneducated class of small producers. The second must be instituted by the Government at the capital of each of the principal abacá-producing provinces, and will serve to enable the producers to market their product where they can obtain better prices, and will also serve to free them from their economic dependence upon the local buyers. Such banks, it is understood, have been successfully instituted for the benefit of the sugar producers of Iloilo and Negros. The abacá crop is much more important to the Filipinos in general than the sugar crop, and the number of people dependent upon the former crop for a living is considerably larger than that depending upon the latter. Besides, the producers of abacá are, on the whole, poorer than the producers of sugar, and are certainly entitled to as much, if not more, attention than the producers of the latter commodity.

BOOK REVIEW.

BY O. W. BARRETT, Chief, Division of Horticulture.

COCOA, ITS CULTIVATION AND PREPARATION.

By W. H. JOHNSON, F. L. S.

This new work on cacao will meet with much favor in British tropical colonies, being as it is a complete handbook for the planter who wishes to put his estate in a thoroughly up-to-date condition. Mr. Johnson, the present director of agriculture for Southern Nigeria, has had thorough training in several of the major tropical crops both in West and East Africa. The author has wisely endeavored to make this book of high value not only to the African planters but to those of Samoa, West Indies, and South America as well. He has not even forgotten the manufacturers in an excellent chapter on "Commercial Cocoa, Its Manufacture and Uses." By the way, it is regrettable that the author has used the obsolescent word "cocoa" to mean not only the manufactured product (which is quite correct), but also the plant and its raw product, thus giving support to the old error which in most tropical countries has fortunately now fallen into disuse.

This work, which is one of the new Imperial Institute series of handbooks on the commercial resources of the Tropics, stands, perhaps, as the most condensed and concise cacao handbook, not to except the works of Wright and Hart, that has come before the public.

It is superedited by W. R. Dunstan, director of the Imperial Institute of Great Britain, and published by John Murray of London. It is another verification of the good old adage, "Ex Africa semper aliquid novum." The *supply continent* of the future is inexhaustibly full of good things—authors included.



Palauan (*Cyrtosperma merkusii Schott.*), the largest cultivated Aroid, Tacloban, Leyte.

THE PHILIPPINE

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CONTENTS.

	Page.
Editorial	469
Bureau of Agriculture Circular No. 24, Citrus Growing in the Philippines	471
Some New or Little-known Philippine Economics	493
Present System of Grading and Baling Abacá (Manila hemp), its Defects, and Remedies therefor	504
Planting Maize	513
Notes on Agricultural Pests	517
Current Notes—October: Levantine Oranges; Banana Diseases; Still More New Coconut Rivals; "Better-farming" Train; Farm Colonies in Brazil; East African Exposition; French Indo China Rice Crop; Margarine Changes; Dika Butter; Texas School of Economics; Hides from South China; Department of Agriculture in the Moving-picture Business; Rice Culture in Japan	521
Temperature and Rainfall for Agricultural Districts in the Philippines—July, 1913	528

121445

ILLUSTRATIONS.

PLATE I. Paláuan (*Cyrtosperma merkusii* Schott); the largest cultivated Aroid. Tacloban, Leyte ..... *Frontispiece.*

Facing page—

II. (*a*) Bóbog (*Sterculia fœtida* L.); (*b*) Bóbog; carpel split open exposing seeds 498

III. (*a*) Sántol (*Sandoricum koetjape* Merr.); (*b*) Sapote Negro (*Diospyros ebenaster* Retz.) 498

IV. Genipap (*Genipa americana* L.). Young tree at the Lamao Experiment Station 498

V. (*a*) Galó; mature specimen; Cavite Province; (*b*) Galó fruits; husked nuts at top 498

VI. Laguan (*Nephelium mutabile* Bl.) 498

VII. (*a*) Pungapung (*Amorphophallus campanulatus* Blume); Corm with flower bud issuing from center; (*b*) Same corm, two weeks later, with fully opened flower; spathe mauve or grayish purple; spadix purple or blackish.. 498

VIII. Uay (*Calamus mollis* Blanco) 498

IX. Pacupis (*Trichosanthes anguina* L.); short, straight variety 498

X. Alubíhod (*Myristica* sp.); Wild Nutmeg. Cavite Province 498

XI. Chico Mamey (*Lucuma mammosa* Gaertn.). Rare fruit in the Philippine Islands; introduced from tropical America 498

XII. Present method of grading and sorting abacá 510

XIII. Preparing abacá for pressing 510

XIV. Present method of pressing and tying abacá bales 510

XV. Abacá bales and method of wrapping 510

TEXT FIGURES.

Page.

FIG. 1. Budding in progressive stages: (*a*) Budwood; (*b*) stock ready for insertion of bud; (*c*) bud inserted; (*d*) bud tied; (*e*) bud unwrapped, twelve days after insertion, stock ready for lopping; (*f*) budding knife; (*g*) bud 477

2. Proper way of cutting a bud 478

3. Lopped plant, showing a sprouting bud 479

4. Method of lopping 480

5. Cleft grafting: (*a*) Grafting tool; (*b*) scion; (*c*) scions inserted 481

6. Indicating manner of pruning budded tree preparatory to planting in the field.. 484

7. Planting board 485

8. Pruning tools 488

9. Proper way to hold the pruning shears 488

EDITORIAL.

DIVERSIFICATION VS. SPECIALIZATION IN AGRICULTURE.

An old proverb says: "Do not put all your eggs in one basket." A famous manufacturer, no doubt having in mind his own experience, thought he would thus improve upon it: "Put all your eggs in one basket and then *watch that basket.*" Broadly considered, we believe that the old proverb is more worthy of consideration by the careful agriculturist, but the latter quotation also contains some profound truths. The wisdom of the sage who propounded the proverb has probably never been questioned by any thinking participant among sufferers from the evil of the single-crop system, whether the direct cause of disaster was frost, drought, overproduction accompanied by a depression of values, diseases, or insect pests—just now so particularly conspicuous in the Philippines in the form of locusts.

We all know that the climatic conditions necessary for the best development of one crop are frequently fatal to another. We also know that the weather of a season is not predictable, nor can anyone foretell in advance with a reasonable degree of accuracy the appearance or nonappearance of certain insect pests—for instance, locusts. Much can be done, however, to mitigate the suffering resulting from the failure of a season's crop by planting a part of the land to other crops which are not so susceptible to the same climatic influences, or to the same insect pests and diseases.

Agriculturally speaking, locusts are at the date of writing one of the most serious problems of the Philippines. Rice and maize being the staple foods of the inhabitants of the Archipelago and coconuts one of the leading crops, locusts will remain a serious menace to the prosperity of the Philippines until a better means of control than is now existent shall have been found. In the meantime, the miseries of a famine caused by a locust visitation could be averted to a very great extent by the planting of other food plants that are not susceptible to them, as, for instance, cowpeas, mungos, cassava, yams, and camotes, not to mention the multitude of fruits that thrive here. It is a fortunate fact,

and perhaps one appreciated by few, that, generally speaking, the tropical fruits are far richer in actual food value than those of the Temperate Zone, which are chiefly valuable as dessert fruits, and therefore far more valuable adjuncts to the table. This is an additional reason why every cottager in the Tropics should provide himself with a liberal assortment of fruit trees.

So much for diversification. The first aim of the tiller of the soil should perhaps be to make the soil furnish him and his most of the foodstuffs needed; the second thought should be for a remunerative money crop. Here is where specialization comes into play and where intelligent judgment wins its highest reward in agriculture. Everybody knows better than to grow a crop for which there is no market, though frequently so many engage in the culture of the same crop that it ceases to be profitable. Every day, however, we see those who engage in the culture of certain crops contending with soil and climatic conditions and we realize that they are so utterly ignorant of the handling of the crop in question as to be foredoomed to failure.

It is perhaps safe to say that practically all failures in investments in tropical agriculture where the money is actually invested are due to the above causes, and that few are brought about by dishonest mismanagement.

The planter who would specialize should make a thorough study of his land and climate, and then ascertain the requirements of the crops in the culture of which he contemplates engaging. He should not attempt to grow such as thrive well only under conditions different from those actually obtaining. Likewise, the prospective investor, in order to be successful, should carefully consider whether the environment in a given locality is well adapted to the plant industry in which he desires to invest, though no less vital is the engagement of a resident manager who is fully conversant with the culture and handling of the prospective crop.

BUREAU OF AGRICULTURE CIRCULAR NO. 24—CITRUS GROWING IN THE PHILIPPINES.

[CIRCULAR No. 24. Manila, August 15, 1913.]

CITRUS GROWING IN THE PHILIPPINES.

By P. J. WESTER, *Horticulturist in Charge of Lamao Experiment Station.*

INTRODUCTION.

At least two species of the citrus fruits are indigenous to the Philippines and all the cultivated species of the genus were introduced long ago. It may be justly questioned whether mandarins of such superior quality and in such large quantities are produced anywhere with so little care and expense as in the so-called "orange district" of Batangas. The Philippines annually import oranges, pomelos, and lemons from not only China and Japan, but from distant California, Australia, and southern Europe, and lime juice from the West Indies. Notwithstanding these facts, there has as yet been no intelligent attempt to supply the growing home market to say nothing of developing an export trade.

Viewed as a whole, with the exception of the mandarins, the Philippine citrus fruits must be classed as very poor; there are, however, seedling trees growing here and there throughout the Archipelago that produce fruit of good quality, and these exceptions are in themselves sufficient evidence that many parts of the Philippines, if not all, are well adapted to citrus growing and that there is little or no excuse for the importation of citrus fruits.

As already stated, the mandarin, *Citrus nobilis* Lour., is the only species in the genus that is cultivated at all extensively. The pomelo, *C. decumana* L., lime, *C. lima* Lunan, calamondin, *C. mitis* Blanco, and the orange, *C. aurantium* L., are important in the order of their enumeration; the cabuyao, *C. hystrix* DC., lemon, *C. limonum* Risso, and the citron, *C. medica* L., are unimportant, and, in fact, it is improbable that any one of the three last-mentioned fruits will ever become of importance in

the Philippines. There is unquestionably a bright future for the cultivation of the mandarin, orange, and pomelo as dessert fruits, and the lime, and to some extent the calamondin, for cooling drinks; the latter may also be made into good marmalade, and there might be a future for a lime-juice industry.

The Bureau of Agriculture has during the last three years imported a large number of superior varieties from abroad, the distribution of which, it is hoped, will stimulate the interest in and the production of better and larger quantities of citrus fruits.

This circular has been prepared to supply the popular demand for practical information relative to citrus growing. It is in fact Bulletn 27,[1] Citriculture, condensed, and several paragraphs relative to practical work are direct quotations from this bulletin.

PROPAGATION.

General remarks.—The citrus fruits may be and at present are exclusively propagated from seed in the Philippines, and this is one of the principal reasons for the poor quality of most of the Philippine citrus fruits. In all countries where citrus growing has developed into an industry, all trees are budded or grafted; of these methods shield budding is the simplest and the most preferable.

With the introduction of better varieties, the fruit from budded trees will readily outsell the seedling fruit, and it is safe to say that we can never hope to build up a successful export trade until the growers realize the importance of grafting and budding.

The following advantages are derived from budding and grafting:

1. A stock best adapted to the soil and climatic conditions can be used, and by this means citrus fruits can frequently be grown in sections where this would be impossible if they depended upon their own root system.

2. Any variety desired can be grown in any quantity desired.

3. By planting budded trees the uniformity of quality and appearance of the fruit is insured, which is highly important in a discriminating export trade.

4. Budded trees are more precocious than seedlings, less spiny, and do not grow so tall; they therefore (*a*) yield a profit earlier than the seedlings; (*b*) the gathering of the fruit is performed with more facility; (*c*) if insect pests and diseases gain entrance into the orchard their control and eradication is more easily effected in low-headed than in tall trees; (*d*) they are not so liable to injury by storms; and (*e*) by shading a larger area of ground they assist in preserving the moisture in the earth during the season.

[1] To be issued later.

5. The season of maturity can be controlled to a large extent by the planting of early or late fruiting varieties.

6. Finally, even with the greatest care in seed selection, seedlings will always vary in productiveness.

Many people are under the impression that a budded tree must of necessity be superior to a seedling irrespective of where the bud came from, as if the budding process had effected some magical transformation in the plant; nothing can be more erroneous, however. *Budded trees produce fruit identical with that of the trees from which the buds were obtained* except in so far as it may be very slightly influenced by a different stock and a different environment. The process of budding itself is not an improvement, but the *means by which the betterment is effected in the grove.* Therefore, in order to be an improvement upon the seedling, the bud *must be procured from a tree bearing superior fruit.*

STOCK.

"Stock" is a horticultural term for a seedling upon which is grafted or budded another variety of the same or another species, or even sometimes of another genus.

Generally speaking, the qualities possessed by the tree from which the scion is taken are retained in the plant budded therewith, but it is also true that the stock and the scion exert a very slight influence upon each other. Also, the climate and soil are determining factors relative to flavor and quality. Therefore, the behavior of an imported variety cannot be predicted with certainty. Imported and untried varieties should for this reason never be planted on a large scale until they have been thoroughly tested.

In the citrus regions abroad the sweet and sour orange, pomelo, rough lemon, and lime are used as stocks. In the Philippines we may add to this list the mandarin, cabuyao, and calamondin, and, in fact, when we consider the great variability among our citrus fruits we have a far greater number of stocks to choose from than these names indicate. Their adaptability for our purpose can of course be determined only by actual experiments. The great variability among the native Philippine citrus fruits indicates that their suitability as stocks likewise must vary to a considerable extent.

The qualities that determine the value of a certain stock are vigor, resistance to certain diseases, its influence on the scion relative to productivity and the quality of the fruit produced, and

also, to some extent, its influence with respect to the habit of the top.

The sweet orange makes a satisfactory stock on well-drained, light soils. It has a well-developed root system and in vigor and rapidity of growth it is surpassed only by the pomelo, the rough lemon, and the cabuyao. The sweet orange, however, is very susceptible to foot rot and should for this reason never be used on low or poorly drained land.

The pomelo makes an excellent stock on dry soils and also succeeds well on those with an intermediate degree of moisture content. The pomelo is one of the most vigorous of the citrus trees, has a well-developed root system, and, as far as known, is exempt from foot rot.

Nothing is known at present of the qualities of the cabuyao as a stock, but because of its general vigor and hardiness it is well worth trial in a limited way.

The mandarin seedling groves in Batangas have been so successful in the past that, while this species is not so vigorous as the species already discussed, it is considered to be well worth a trial on well-drained loamy lands.

The lime is short-lived and less vigorous than most species in the genus and has a weak root system. It should, therefore, never be used as a stock where other species will serve equally well.

In common with the cabuyao, the calamondin has never been used as a stock, but considering its drought-resistant qualities it also is worth trying as a stock in all localities where it is found to succeed well.

The sour orange and the sweet lime are also used as stocks abroad, but, since they are not at present available for the Philippine planter, they are not considered here.

NURSERY.

General remarks.—The nursery should be located in a sheltered situation on fairly level, well-drained land consisting of a clayey friable loam, rich in humus. Where distinct wet and dry seasons prevail, provision for artificial irrigation should be made either by surface irrigation or by the erection of a small irrigation plant which may consist of a ram with tank where the fall and water is ample, or of a gasoline or oil engine and pump.

The land should be thoroughly worked over to a depth of 30 centimeters and all trash and stones removed, and the land

planted for one year to some leguminous cover crop, such as the Lyon or velvet bean, cowpeas, or mungos. These should be plowed under at the end of the season.

For the best results it is advisable to erect a small plant shed of bamboo admitting half light in which to sow the seeds and to rear the young seedlings until they are ready for the nursery in the open field.

Seed boxes.—When the propagation is made on a small scale, it is best to germinate the seed in a box and to transplant the seedlings into the bed in the shed when they are 5 or more centimeters high. Convenient boxes for this purpose may be made by sawing kerosene boxes in two, or special boxes may be made 40 centimeters wide, 60 centimeters long, and 10 centimeters deep. Several holes should be bored in the bottom for drainage. When boxes are made, in nailing on the bottom boards, allow a space of about 3 to 5 millimeters between the boards to provide for drainage.

Cover the bottom of the box with gravel, small stones, or coal ashes to a depth of about 2 centimeters, fill it to within a centimeter of the rim with soil, level off, and plant the seed.

If the nursery is conducted on a large scale, it is best to sow the seed in a seed bed. The seed bed should be made just wide enough so that the middle of the bed can be easily reached for the performance of all work connected with the growing of the plants. About 1.5 meters is a convenient width. The beds should be separated by paths 40 to 60 centimeters wide.

The subsequent health of the trees in the orchard depends largely upon the vigor of the stock; therefore, well-developed seeds should be selected from the mature fruits of healthy, vigorous trees. The pulp should be washed off and the seeds dried for a day or two in the shade and then planted. Sow the seeds rather thickly, in rows 5 to 10 centimeters apart, and cover them with about 1 centimeter of soil.

Other conditions being favorable, satisfactory germination can be obtained only by having the soil in the seed bed light, sandy, and friable. If it is not, sand and decayed vegetable matter should be added and worked in until the soil is in the desired condition.

After the seed has been sown, the seed flats, or the bed, should be watered from time to time and the soil should never be allowed to dry out. The waterings should be liberal and thorough. A light watering that only moistens the surface is

harmful rather than beneficial in that it encourages a shallow root system. After germination, water should be applied more sparingly, else the tender plants are apt to "damp off."

In regions with distinct wet and dry seasons the seed should preferably be sown sufficiently early in the dry season to make a plant 8 to 10 centimeters tall before the advent of the rainy period, for the rains are liable to destroy the tenderer plants.

Transplanting.—As soon as the plants begin crowding each other they should be transplanted. The first shift should be done in the plant shed to beds prepared for this purpose and the seedlings set out 10 centimeters apart each way. At all times, unless the soil is well moistened or the work accompanied by a good shower, the plants should be thoroughly watered before and after transplanting and care should be exercised not to permit the plants to dry out in the course of the work. The transplanting is best performed by the aid of a dibber, which is thrust into the soil, making a hole for each plant. It is most important that in transplantation the roots be not doubled up or placed in an unnatural or forced position. Such plants are incapable of promptly establishing a well-balanced root system that will anchor the tree well, and sooner or later the trees may be blown over.

When 20 or more centimeters tall the plants are ready for transplantation to the field nursery. Then prune off about two-thirds of the foliage and the tender growth and also cut back the taproot in order to encourage a well-balanced root system.

In the nursery the plants should be set out 30 to 40 centimeters apart in rows 120 to 150 centimeters apart in order to provide sufficient space for budding and cultivation. The nursery should be kept free from weeds, and in those sections of the Archipelago where dry seasons of greater or less duration are prevalent, it should be irrigated from time to time. A mulch of straw or weeds is beneficial.

BUDDING.

Some judgment must, of course, be exercised in all phases of work; but the art of budding itself is very simple—in fact, a mere matter of manual skill that anyone who is at all deft in handling a knife should be able to master. The essentials for success in budding are:

1. Stock plants in condition for budding, i. e., the flow of sap must be good so that the bark separates readily from the wood.

2. A suitable budding knife (fig. 1, *f*) the edge of which should be sharp and keen as a razor, and clean of all impurities; an ordinary pocket knife will hardly answer the purpose.

3. Proper bud wood (fig. 1, *a*). Immature bud wood will not "take" and the cutting of buds from old and hard bud wood is difficult.

4. The bud wood should never be permitted to dry from exposure to air or sun.

5. The buds should be inserted immediately after being cut, and the bud tied at once.

6. No foreign matter or water should be allowed to enter the bud incision.

7. The bud should be cut so that there is no break or tear in the tissues.

When the stock plants have attained the thickness of 1 centimeter they are ready for budding. If the plants are in good



Fig. 1. Budding in progressive stages.

(*a*) Bud wood; (*b*) stock ready for insertion of bud; (*c*) bud inserted; (*d*) bud tied; (*e*) bud unwrapped, twelve days after insertion, stock ready for lopping; (*f*) budding knife; (*g*) bud.

condition for budding, this work may be performed at any time of the year. However, for practical purposes, it is inadvisable to bud during the rainy season, as the dry season is far more favorable.

The greatest care should be exercised in taking bud wood only from thrifty and vigorous trees in good health, which produce good-quality fruit in abundance. Thorny wood should be rejected so far as possible, since continued selection of thornless bud wood during several bud generations will in most cases, at least, greatly reduce the size of the thorns, if not entirely eliminate them; furthermore, it is much easier to cut buds from a smooth than from a thorny bud stick.

The first, second, and third growth from the top, well matured, is the best wood for budding; older wood is too hard and likely to split in cutting the buds.

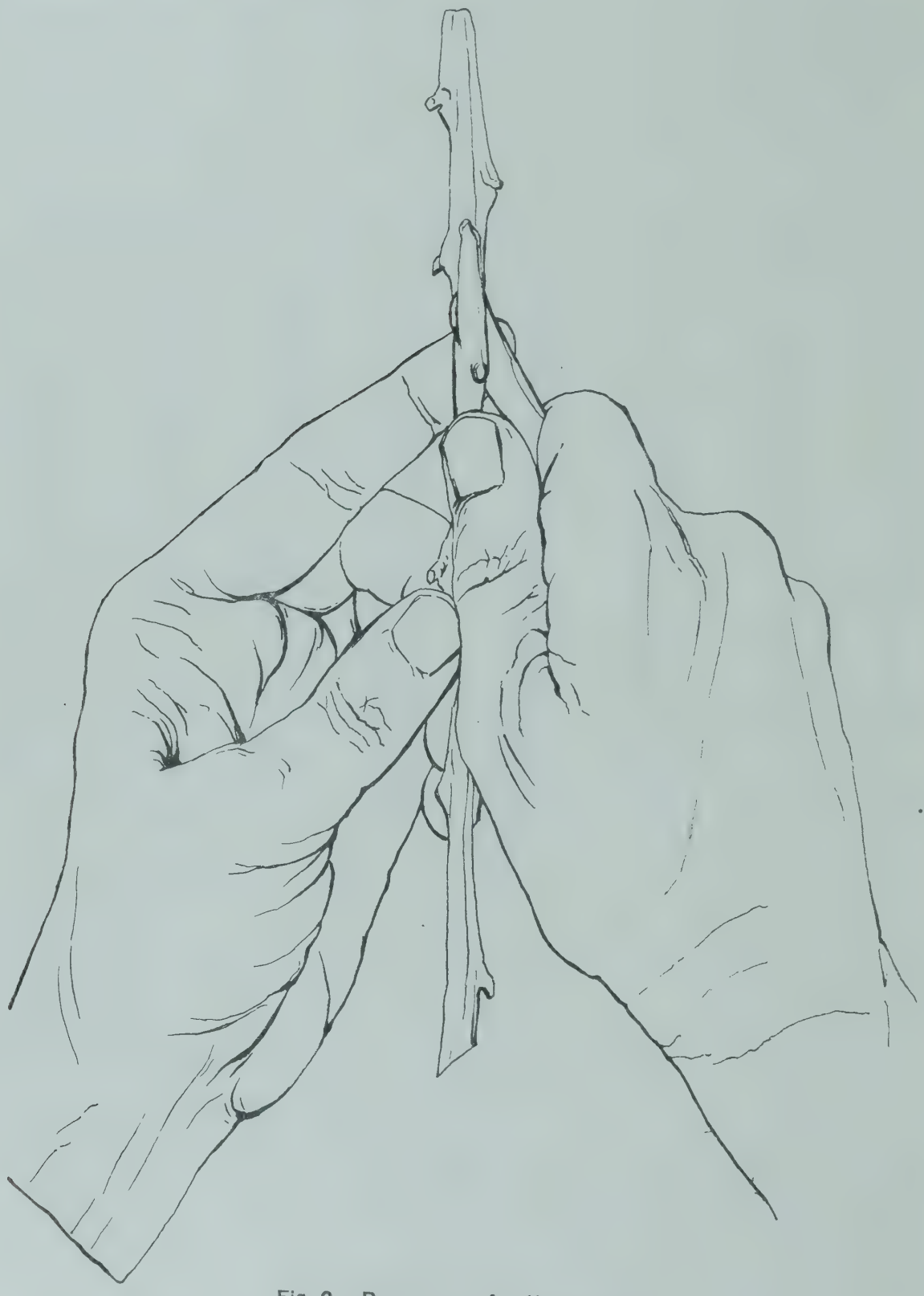


Fig. 2. Proper way of cutting a bud.

Round instead of angled bud wood is always to be preferred in general practice, though angled bud wood may be used.

Before the actual budding is begun, the nursery should be

weeded, and all twigs, spines, and leaves trimmed off the stock to a height of about 20 centimeters from the ground.

The budding operations should then the performed in the following order: First, make a vertical incision about 3 or 4 centimeters long with the point of the knife, passing through the bark to the wood of the stock; then at the lower end of this make a horizontal cut, resulting in a wound like an inverted T; then, in order to facilitate the insertion of the bud, lift the bark by passing the point of the blade under the bark upward along the vertical incision, loosening the bark sufficiently so that the inserted bud slips into place easily (fig. 1, *b*); next, cut a bud, not less than 2 centimeters nor more than 4 centimeters long, by passing the knife *diagonally* under the bud (fig. 2), taking care not to shave it too thin and that no break or tear is made in the tissue, which is liable to happen if the knife is held at too great an angle with the bud stick; in cutting the bud it is best

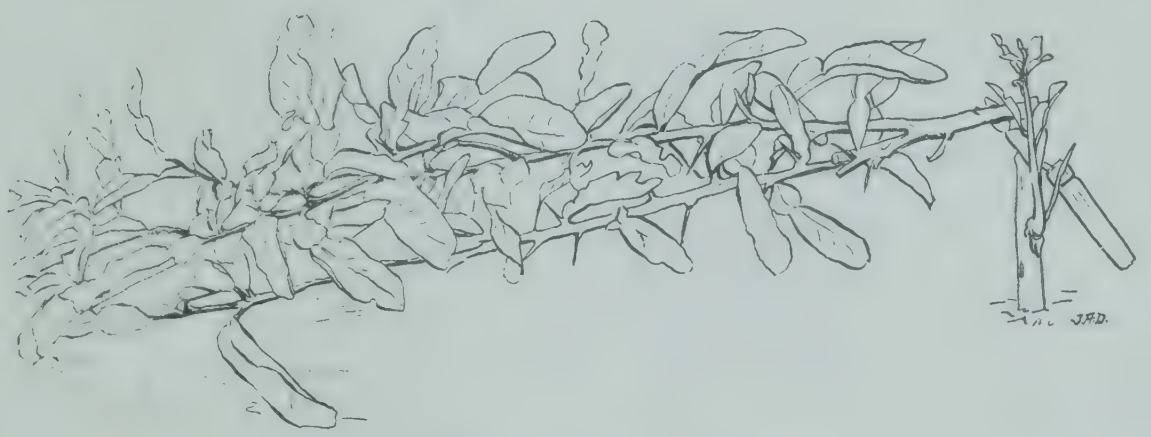


Fig. 3. Lopped plant, showing a sprouting bud.

to hold the tip end of the stick downward, as the wood is then less likely to split during the process than if it were held in the reverse position; now insert the bud and tie firmly, without strangling, with grafting tape, beginning at the point of insertion and covering the entire incision so that no water can enter (fig. 1, *c* and *d*).

Raffia and soft cotton string are also used as tying material, but the author has found waxed tape preferable.

Ten to fourteen days after the buds have been inserted they should be examined and where they have "taken" the trees should be lopped. This is done by cutting with a knife or a pruning saw one-half or two-thirds through the stock about 5 to 10 centimeters above the bud (fig. 3). Then bend the tops over, care being taken not to split the stock *downward*. The lopped tops of two rows should be turned so as to meet each other in order to allow cultivation and free passage in each alternate space (fig. 4).

After the plants are lopped they should be gone over every week and all "wild" sprouts rubbed off. This work is most important, for if it is not attended to the stock sprouts soon gain the upper hand and hence the buds frequently fail to start at all. When the bud has made a growth of 30 or more centi-



Fig. 4. Method of lopping.

meters and the wood is well ripened so that there is no danger that it will break off at the point of union, cut off the remaining part of the stock top just above the bud sprout with a sharp knife. If the budded plants have a tendency to fall over, they should be loosely tied to stakes; split bamboo canes about 1.25 meters tall may be used for this purpose. When the new bud

shoots have attained a height of 1 meter or more they are ready for planting in the field.

If in reasonably good condition, old trees may be made to produce good fruit by "top-working."

Two methods may be employed in top-working old citrus trees—grafting and shield budding. If it is desired to graft the trees, about two-thirds of the limbs and branches should be pruned back. The remainder of the top will serve as a protection against sun scald by shading the trunk and limbs that are being top-worked until the grafts have developed a new top. The stumps are then split with a stout, sharp knife or a grafting tool, and a wedge-pointed scion of well-matured wood inserted; two

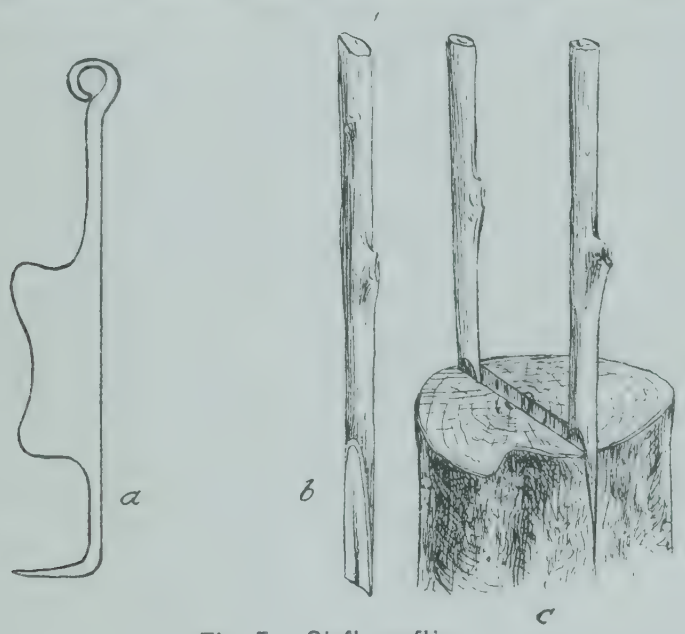


Fig. 5. Cleft grafting.

(*a*) Grafting tool; (*b*) scion; (*c*) scions inserted.

to four grafts or even more may be inserted in the same stump, according to its size. The scion should be 10 to 12 centimeters long and carry 3 or 4 buds, and the "wedge" at the base should be about 4 centimeters in length (fig. 5). Great care should be taken to see that the cambium layers of the stock and the scion are placed in close contact with each other, for otherwise no union can form. After insertion the stocks should be firmly tied with waxed cloth and all cut surfaces well covered with grafting wax to prevent the escape of moisture from stock and scion by evaporation as well as to preclude the entrance of extraneous moisture and germs into the wounds. As the new top develops, the native growth should gradually be removed and all large wounds carefully painted with white lead. If the scions for any reason should fail, the sprouts from the stumps may be budded and treated as already described under shield budding.

If in the course of top-working it is desired to bud instead of graft the old trees, prune back the trees as already described under grafting and bud the young growths when large enough for the purpose.

PREPARATION OF GRAFTING WAX AND TAPE.

Wax cloth for tying is prepared as follows: Beeswax, 2 kilograms; resin, 2 kilograms.

Place the ingredients in an iron pot and melt over a slow fire.

The best material for grafting tape is cheap cotton cloth that tears easily. Rip the cloth into strips 15 to 20 centimeters wide, and wind the strips of cloth on stout iron wire until the roll is 5 centimeters in diameter; if thicker, the wax penetrates with difficulty to the center. To prevent the cloth from unrolling, tie strings around the ends of the roll. The weight of the wire will sink the rolls in the mixture while the cloth absorbs the wax. If the cloth is rolled on wooden sticks the rolls must be weighted down. Keep the rolls in the melted wax for about fifteen minutes to saturate the cloth. Do not permit the mixture to boil else the cloth may be burned.

When required for use, unroll the cloth and tear it into strips about 2 centimeters wide.

If twine is desired for tying, procure balls of cotton twine and place them in the melted wax like the cloth.

FIELD CULTURE.

A loose friable soil is the most suitable, but citrus trees will also succeed well on heavy soils, provided that they are not too shallow and that they are well drained. Very rich soils with abundant moisture are apt to produce coarse and poorly flavored fruits; lands of average fertility are to be preferred.

Well distributed throughout the year, a rainfall of 1,000 to 1,250 millimeters is sufficient, but where most of the rain falls in the course of a few months followed by a long dry period irrigation is necessary for the best results. The ill effects of a prolonged dry season, where irrigation is not practicable, may to a considerable extent be mitigated by the judicious use of mulches and cover crops combined with surface cultivation during the dry period.

CLEARING.

Uncultivated land should preferably be cleared and planted to a leguminous cover crop a year previous to the planting of the grove, but the grove may also be started by clearing away the

heaviest native growth and preparing a circular space for each tree. This space should be enlarged annually as the trees increase in size until ultimately the land is entirely cleared.

PLANTING.

The citrus fruits vary considerably in vigor and the trees of the different species should be spaced accordingly.

The following distances are recommended:

	Meters.
Oranges	7 to 9
Mandarins	6 to 7.5
Pomelo	8 to 9.5
Lemons	7 to 8.5
Limes	5 to 6

Care should be taken to lay out the grove in straight parallel rows with the trees equidistant, both for the sake of appearance and particularly in order to facilitate all subsequent work in the grove.

Except where rainfall is evenly distributed throughout the year or where irrigation is inexpensive, it is best to set out the trees at the beginning of or sufficiently early during the wet season to enable the trees to become well established before the advent of the dry period; by doing so the expense of watering is saved.

Dig the holes from 75 to 100 centimeters in diameter and 35 to 50 centimeters deep according to the size of the trees to be planted. In planting the trees fill the holes with surface soil; the subsoil dug out of the holes should be spread out between the trees.

About one-third of the foliage and tender growth should be pruned off the trees in the nursery before they are taken up in order to reduce evaporation; all straggling and injured roots should also be cut off (fig. 6).

In the transfer of the trees from the nursery to the field do not permit the roots to dry out. Keep the plants well shaded with grass, straw, or sacking and sprinkle them with water whenever the covering dries out.

The planting board (fig. 7) is a very simple contrivance and very useful in that it automatically places the tree in the exact position of the stake and also guides the planter as to the proper depth at which to plant the tree. Place the board so that the central notch fits the tree stake and drive a small stake in the ground in each notch at the ends of the board, then remove the

board and the central stake and dig the hole; replace the board so that the two small stakes fit in the end notches and plant the tree so that it fits in the central notch.



Fig. 6. Indicating manner of pruning budded tree preparatory to planting in the field.

Be sure to make the holes sufficiently large so that the roots can be planted in a natural position. Carefully work in and pack the soil around the roots, leaving no cavities. Citrus trees

should never be planted deeper in the field than they grew in the nursery. As the soil usually settles more or less around a newly planted tree it is well to set out the plants so that the crown roots are about 3 to 5 centimeters above the general level of the land.

Unless the planting is followed by a good rain, a basin should be made around each tree and 10 to 20 liters of water applied to each plant and a heavy mulch of leaves, straw, or weeds placed around each tree.

There is considerable vacant space in a young grove which may be utilized for subsidiary or cover crops, such as upland rice, corn, yams, camotes, etc. Quick-growing fruits such as the banana, pineapples, and the papaya may be also interplanted with the newly set citrus trees. The auxiliary crops should never be allowed to remain to the detriment of the main crop, nor should their cultivation be carried on so close that the roots and trunks are injured by the work animals.

The cowpea, mungo, velvet bean, Lyon bean, and guar may be used as cover crops. Of these the cowpea, mungo, and guar are



Fig. 7. Planting board.

the most suitable. These should be planted at the approach of the rainy season. At the end of the rainy season place the loose trash around the trees for mulch, and give the land a shallow plowing. Unless the land is now planted to vegetables or some other short-season crop, keep the soil stirred up now and then during the dry season with a shallow cultivator.

At the end of the dry season the middles should be plowed deeper, say, from 15 to 30 centimeters, preparatory to the planting of the cover crop. This is done in order to encourage the formation of a deeper root system, which again enables the trees to better resist the effects of prolonged dry periods. The depth of this plowing should vary from year to year, say, 15 centimeters the first year, 20 centimeters the next, then 25 centimeters, and 30 centimeters the fourth year. Then begin again with a depth of 15 centimeters.

All mulch and trash should be raked away for a space of 50 centimeters from the trunks of the trees during the rainy season and care taken that there are no depressions in the ground near the trees where water may collect and become stagnant.

FERTILIZATION.

Generally speaking, the average Philippine soil adapted to citrus fruits is sufficiently rich in plant food so that applications of artificial fertilizers are not necessary to bring the trees into fruiting, especially after the trees have become established. On poor land it may be advisable to manure the trees, and a small amount of fertilizer well incorporated in the soil around the roots of newly planted trees on newly broken land will greatly stimulate their growth until with the continued cultivation of the land and the plantng of cover crops the soil bacteria become sufficiently active.

The fertilizers in the following table may be obtained in Manila and the formulas recommended are based upon the supposition that the analysis of the ingredients conforms to that in the table. The amount used of any ingredient analyzing differently should be greater or less according to the analysis.

Name of fertilizers.	Composition.		
	Nitrogen.	Potash.	Phosphoric acid.
	Per cent.	*Per cent.*	*Per cent.*
Nitrate of soda	16		
Sulphate of ammonia	21		
Dried blood	14		
Bone meal	5		20
Tankage	4		22
Sulphate of potash		49	
Basic slag			20
Double superphoshate			50

FORMULAS FOR YOUNG TREES.

Nitrogen, 4 per cent; potash, 7 per cent; phosphoric acid, 6 per cent.

Formula No. 1.

Dried blood	Kilograms	286
Sulphate of potash	do	143
Double superphosphate	do	120
Makeweight	do	451
		1,000

Formula No. 2.

Nitrate of soda	Kilograms	63
Sulphate of ammonia	do	143
Sulphate of potash	do	143
Double superphosphate	do	120
Makeweight	do	531
		1,000

Formula No. 3.

Bone meal	Kilograms	300
Sulphate of ammonia	do	130
Sulphate of potash	do	143
Makeweight	do	427
		1,000

FORMULA FOR BEARING TREES.

Nitrogen, 3 per cent; potash, 12 per cent; phosphoric acid, 8 per cent.

Nitrate of soda	kilograms	60
Sulphate of ammonia	do	100
Sulphate of potash	do	245
Double superphosphate	do	160
Makeweight	do	435
		1,000

The formulas for young trees provide for a mixture of 1 metric ton or 1,000 kilograms analyzing 4 per cent nitrogen, 7 per cent potash, and 6 per cent phosphoric acid. The formulas for bearing trees analyze 3 per cent nitrogen, 12 per cent potash, and 8 per cent phosphoric acid. A glance at formula No. 1 for young trees shows the constituents to be dried blood, 286 kilograms; sulphate of potash, 143 kilograms; and double superphosphate, 120 kilograms; a total of 549 kilograms. This is a highly concentrated mixture, and should either be diluted with makeweight of 451 kilograms of dry soil in order to give it the desired analysis or else correspondingly smaller amounts of fertilizer should be applied. The remark relative to the concentrated form of the fertilizers and the necessity of dilution refers, of course, to all the formulas to a greater or less degree. The fertilizer should always be well pulverized.

The amount of fertilizer applied should be gauged by the fertility of the soil and the size and age of the trees. One-half to 1 kilogram of fertilizer analyzing 4 per cent nitrogen, 7 per cent potash, and 6 per cent phosphoric acid may be incorporated with the soil around each tree according to size at the time of planting, care being taken that it is not placed too near the crown roots of the trees. As the trees grow larger the fertilizer may be applied in increasingly greater amounts if the trees show the need of it. Two applications may be made annually, one at the approach of the rainy season and one after its close. As the trees grow larger the fertilizer should be applied broadcast in the orchard well away from the trunks of the trees. If leguminous cover crops are used, the nitrogenous fertilizer can unquestionably be entirely dispensed with after the land is brought to the proper tilth. This applies to young as well as growing trees.

PRUNING.

Every orchard should have a set of pruning tools, consisting of a pruning knife, pruning shears, pruning saw, and a tree

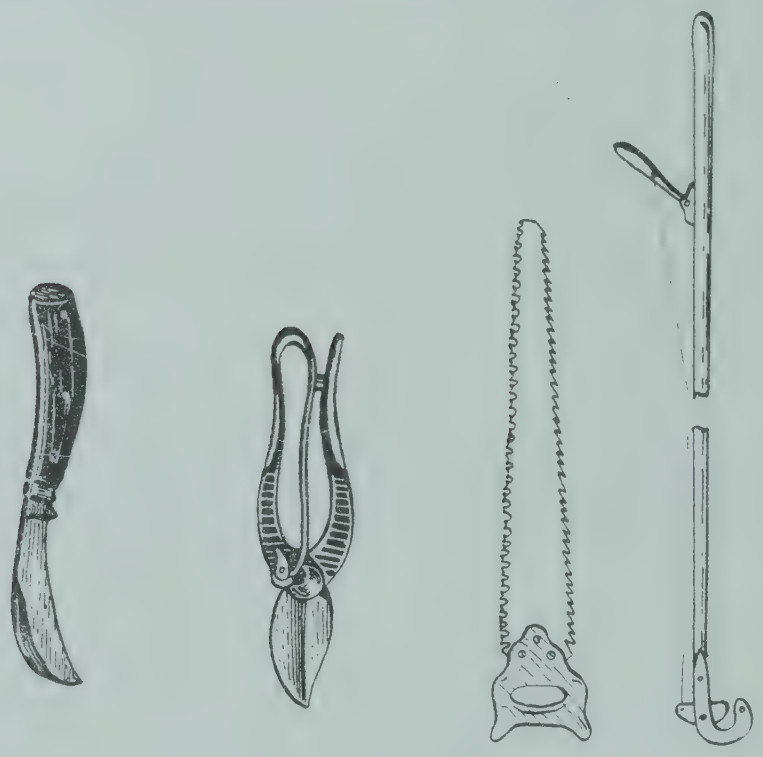


Fig. 8. Pruning tools.

pruner for tall trees (fig. 8). Good work can be done only when good tools are used, and if local stores do not keep a supply



Fig. 9. Proper way to hold the pruning shears.

of tools of good quality it is best to write to some seed house in Australia or the United States.

Excepting the lemon, the citrus fruits, when they are in good condition, require practically no pruning at all after they have become well established. The pruning of a healthy tree should be limited to the pinching back of young growths with the view of making a well-balanced top, and to the removal of interlocking branches that injure each other when moved by the wind. All diseased or dead portions of the tree should be pruned away.

Once every year before the grove is being plowed and put in shape for the rainy season all the trees should be examined and all diseased or dead portions of the trees should be pruned out. See that all pruning tools are sharp, else the work cannot be done properly. Smooth cuts are essential for the rapid healing of the wounds. The cuts should be made as close as possible to the remaining part of the tree. In order to leave no stubs, the pruning shears should be held so that the blade is nearest the tree in the act of pruning (fig. 9). All cuts of any considerable size should be painted with white lead, linseed oil, or coal tar. Gather and burn all prunings at once.

RENOVATION OF OLD GROVES.

There can be no doubt but that the old citrus groves in the Philippines would derive much benefit from a change in their management. Most of them are not cultivated at all at present; too drastic a change, however, is likely to be disastrous to the trees and to invite gummosis and die-back. The first plowing should, therefore, not be made deeper than 15 centimeters nor should the land be plowed closer than 1.75 to 2 meters to the trees. This plowing should be made at the end of the dry season and the land planted to a cover crop. The unplowed land close about the trees should be given a shallow hoeing. During subsequent years the depth of the plowings may be increased.

All diseased and dead limbs and branches should be carefully pruned out of the trees and in many instances it may be decidedly beneficial to cut off one or more of the multiple trunks that usually make up a tree and thus assist the tree in making a new top. The pruning should be done after the fruit is harvested and before the advent of the rainy season. There can be no doubt but that many trees would be further benefited by top-working them to better varieties.

WINDBREAKS.

Where the natural growth of the land is sufficiently robust to serve the purpose an excellent windbreak is already provided for the grove by merely leaving this growth undisturbed around

the grove. If the grove is located in the open country, in a region more or less visited by severe winds, an artificial windbreak must be provided by planting around the grove trees that are not easily uprooted and whose tops are not easily injured by the wind. The mango, tamarind, and the mabolo are well adapted to use as windbreaks and at the same time produce fruits that, in the case of the mango, are particularly valuable. The bamboo also makes a good windbreak and at the same time is valuable for its stems.

HARVESTING AND MARKETING.

Simple and crude as are the methods of handling the citrus crop in the Philippines, the fruit being shipped only a short distance and consumed within few days after it is picked, they meet the present conditions fairly well, and the loss of fruit is not excessive. This loss could be further reduced by more careful handling and by clipping instead of pulling the fruit from the trees.

Fruit grown for export should, or, in fact, *must* be, better handled and packed; this subject is not within the scope of this circular. Those who are interested in growing fruit for export should consult Bulletin No. 27, "Citriculture in the Philippines," in which modern methods of harvesting and marketing citrus fruits are discussed at some length.

CITRUS PESTS.

Broadly considered, the citrus trees in the Philippines are subject to the following pests: Plant parasites, diseases, and insects. The plant parasites are certain plants that grow on and receive their nourishment from the trees which they infest at the expense of their host. The parasite is readily recognizable among the foliage of the citrus trees, and every grower should make an annual inspection tour among his trees and prune out every vestige of the parasite. In order to prevent infestation it is also well to eradicate the parasites from the trees surrounding the grove.

So far the citrus trees in the Philippines seem to have been exempt from the more serious diseases that have wrought more or less havoc to the citrus industry in other countries. The condition of the groves in Batangas is believed to be largely due to temporary and local cultural causes more than to any specific trouble.

Gummosis is a not infrequent physiological disease in the Philippines that is distinguished by the appearance of a gummy

substance mainly on the trunk and larger branches of the trees; the tree looks unthrifty and the branches gradually die back. Excess of nitrogen, malnutrition, and unfavorable conditions generally are believed to be responsible for gummosis. Prune out all diseased parts of the tree, exclude all domestic animals from the grove, and aërate the soil by plowing and harrowing, afterwards letting the land lie fallow and grow up to native vegetation.

Die-back is also a purely physiological disease and is caused by an excess of organic nitrogen in the soil or by a wet soggy soil. Die-back is recognized by the dark-green, unnaturally large leaves and the elevations or blisters on the young twigs filled with a gummy resinous substance which frequently break open; the formation of multiple buds is another sign of die-back. Unless remedial measures are taken the top gradually dies back until the tree succumbs to the disease. Remove all conditions that are conducive to the disease, prune back the trees severely to healthy growth, and where excess of nitrogen is believed to be responsible give the trees a liberal application of a fertilizer containing phosphoric acid and potash. The pruning should be followed by an application of Bordeaux mixture, repeated within a month if necessary. (See Circular No. 12, "Plant Pest Remedies.")

Scab is recognized by the corky and rough elevations that appear on the leaves and young twigs of young plants. Prune out the worst affected parts of the plants and spray with Bordeaux mixture. Repeat the spraying at intervals of fifteen to twenty days until all traces of fresh infestation disappear.

Sooty mold is a fungus that grows in the "honey dew" excreted by various sucking insects that live on the leaves, twigs, or fruit. Eradicate the insects by the application of contact sprays.

Bark rot.—This trouble, which has been noticed in the citrus district of Batangas, is recognized by the formation of putrid sores on the trunk and the larger branches, about the size of a 10-centavo piece or larger. In the course of time the sores heal and the bark sloughs off leaving the tree full of scars with the dead wood exposed. Unless the disease is arrested, the tree eventually dies. All dead trees and those beyond recovery should be dug out and all parts, including even the large roots, should be burned. All dead or weak growths should be carefully pruned out of the remaining trees, and the decayed areas of bark and wood tissue should be cut out and burned. The wounds should be painted with a mixture of equal parts of crude carbolic acid and water. Do not apply the mixture so heavily that it

spreads over the live tissue or runs down over the sound portions of the bark, for it is extremely poisonous and is deadly to all living tissues.

The most serious citrus insect pest is the rind borer, which is the cause of the "lumpy" and unsightly appearance of so many of the oranges and pomelos in the Philippines. The life history of the insect has not yet been the subject of study and no remedy can at present be positively recommended.

The gathering and burning of all infested fruits before the emergence of the full-grown insects would serve to diminish the pest. Possibly these small moths could also be caught with traps, or lanterns, placed above shallow pans filled with kerosene and water and distributed about the grove.

Generally speaking, the scales and other sucking insects that attack the citrus trees in the Philippines are kept well in check by fungi or insect enemies. Where they become a serious menace to the trees they may be readily controlled by judicious spraying with contact sprays (for the preparation and use of which see Bureau of Agriculture Circular No. 12, "Plant Pest Remedies").

The orange grasshopper sometimes causes considerable damage to the lime and the lemon in some districts of the Visayas and in Mindanao. They are readily controlled by spraying the affected trees with Paris green or arsenate of lead prepared according to the formulas in the above-mentioned circular.

SOME NEW OR LITTLE-KNOWN PHILIPPINE ECONOMICS.

By O. W. Barrett, *Chief, Division of Horticulture.*

From a purely botanical standpoint the Philippine flora is comparatively well known even in the mountainous districts of the interiors of all the islands with the possible exception of Mindanao. There are, however, undoubtedly a large number of economic plants and even first-class fruits which are not yet known horticulturally. Recently a cursory survey of Cavite Province has revealed the existence of several quite promising, not to say commercially important, indigenous fruits. The horticulturists of this Bureau have, therefore, come to the conclusion that we should not give up exploring our own country for new and interesting economics, though this does not mean that we should in any way check the importation of valuable fruits and plants from neighboring countries.

The following list with brief descriptions will, it is hoped, illustrate the above point and draw attention to the fact that the Philippine forests are full of plants of interest both to the horticulturist and to the general public.

CULIÁT.

(*Gnetum scandens* Roxb.) [1]

The plants of this genus, holding a rather anomalous position in the vegetable kingdom, ranking just above the conifers, may be classed as economics here in the Philippines both on account of their peculiarly grained wood and their reddish-yellow fruits which contain large edible seeds. These chestnut-like seeds, 2 to 3 centimeters in length, are inclosed in a dry, or slightly juicy, reddish pulp; when roasted like chestnuts, or boiled, they have an excellent flavor. If properly handled on the coals, the somewhat oily seed has the delightful fragrance of fresh roasted coconut "meat."

[1] Acknowledgment is gratefully made to Mr. E. D. Merrill, botanist of the Bureau of Science, for assistance in verifying the nomenclature of the following species.

ALINGÁRO.

(*Eleagnus philippense* Perr.)

A shrubby vine, occurring along roadways and at the edges of forests; obviously worthy of cultivation. Not only are the leaves beautiful, but the pinkish-red fruits, 2 to 3 centimeters in diameter, are decidedly handsome when the crop is ripe. Two varieties of this plant are known, one producing sour and the other sweetish fruits. The pale-red pulp may be either eaten raw or used in making a first-class jelly.

BALUBO.

(*Diplodiscus paniculatus* Turcz.)

A small forest tree of the Tiliaceæ, attaining a height of 10 to 15 meters, found in the Cavite forests. The fruits, oblately globose in shape, and 3 to 4 centimeters in diameter, are borne in clusters at the tips of the branches; each fruit contains 4 seeds which, when boiled, resemble large lima beans both in shape and flavor, and are very highly esteemed by the local inhabitants. These seeds, which are in season from June to August, may be dried and stored for future use.

BALÚBAT.

(*Eugenia* sp.)

This is one of the little-known plants of a good old genus which has furnished the world with two or three dozen first and second class fruits, such as the tampói, or rose apple, and the macopa, or Malay apple. The balúbat attains a height of 5 to 10 meters and bears very fragrant pinkish-white fruits having a very considerable amount of juicy aromatic pulp. The fruit contains one or two seeds and ripens at the end of the dry season.

CUBÍLI.

(*Cubilia blancoi* Blume.)

This unfortunately rather rare forest tree belongs to the Sapindaceæ. It is one of the most esteemed nuts of the Cavite forest. The seeds, which are about the size of a Spanish chestnut, may be eaten either boiled or roasted; in the latter form they resemble, or perhaps excel, the best chestnut both in the way of the fine flavor and in the texture of the yellow fecula. These very interesting nuts ripen during the dry season.

LÍGAS.

(*Semecarpus cuneiformis* Blanco.)

This widely distributed and always dangerous forest shrub attains a height of 3 to 6 meters and maintains a more or less charmed existence. Not only is the wood exceedingly poisonous (when burned, even the smoke being injurious), but the dew or rain dripping from the buds and leaves upon the innocent passer-by may cause itching, if not blistering, of the skin or severe injury to the eyes. Like its cousin, the cashew nut, or casoy (*Anacardium occidentale* L.), the seed is borne at the tip of the "fruit;" this so-called fruit, i. e., the fleshy peduncle, is covered with a reddish-yellow skin somewhat like that of the cashew nut, and contains a rather dryish, sweet, white pulp quite free from fiber. The huge clusters of these beautiful fruits, appearing in May, render this plant a striking object in the forest.

A sister species (*S. gigantifolia* Vidal) occurs in the Bataan forests and bears on the branchless palm-like trunk great masses of purplish or yellowish fruits from 3 to 5 centimeters in length; these are said to be even better than the much smaller fruits of the common lígas.

TALBAC.

(*Alpinia elegans* K. Sch.)

This ginger-like giant herb grows along forest streams, attaining a height of 2 to 4 meters. In the rainy season at the tops of the leafy stems appear large clusters of pale pinkish fruits containing a delicious, spicy, white pulp and many small, black seeds.

In this connection it may be stated that for some unknown reason the lint formerly used in producing fire without the aid of matches was dipped in a strong decoction made by boiling the fragrant but strongly pungent root of this herb; presumably the resinous, or oily, substance obtained by boiling the root imparted some property to the lint which enabled it to quickly take fire from the spark.

TIQUIS-TIQUIS.

This is probably another species of *Alpinia,* although the name in Tagalog applies to any sort of *Canna.* The plant occurs in the jungles of Cavite where it attains a height of about 1 meter. The small whitish flowers are followed by white fruits containing a sweet pulp around the single seed. This form will

probably not endure cultivation, since it undoubtedly requires shade and a very humid atmosphere; but a few plants will be tried out at the Singalong experiment station.

CALOMPÍT.

(*Terminalia edulis* Blanco.)

This magnificent large forest tree occurs, not very commonly, in the Provinces of Bataan and Cavite. In the rainy season abundant crops of black cherry-like fruits, about 2 to 3 centimeters in diameter, are produced. Each fruit contains one seed surrounded by a sweet pulp somewhat resembling that of the Dúhat (*Eugenia jambolana* Lam.) in flavor. This pulp with the addition of lemon or some other acid juice makes a beautifully colored jelly.

CALUBCÚB.

(*Eugenia calubcob* C. B. Rob.)

This is still another of the many Philippine Eugenias, and one whose fruits are really important in Philippine horticulture. The tree attains a height of 5 to 10 meters. The fruits, when ripe, are of a pale yellow shade, somewhat resembling large ripe guavas. The crisp, delicious, sweet pulp, somewhat like that of the rose apple, has a faint lemon-like flavor, but lacks the delightful bouquet of the Balúbat. Seeds from 1 to 3.

TAGPÓ, OR TAGPUNG-PULA.

(*Psychotria* sp.)

A rather rare forest shrub belonging to the Rubiaceæ, or coffee family; height, 1 to 2 meters; habitat, Cavite. The fruit, somewhat resembling that of the Bignay (*Antidesma bunius* Spreng.), has one seed in a soft, rather dry, sweet, red pulp. This shrub is certainly worthy of cultivation, not only for its fruits which may be used in jams and jellies, but because of its prolificness; three crops per year are usually produced.

CABÍQUI.

(*Mimusops elengi* L.)

This small tree of rather wide distribution is closely related to the sapodilla, or chico (*Achras sapota* L.) The fruit, a dull-red or purplish oblong berry 2 to 3 centimeters in length, has a sweet aromatic pulp, excellent for jams or for eating out of hand.

SAPÍMIT.

(*Rubus rosæfolius* Smith.)

One of the several wild raspberries of the Philippines, occurring in clearings in forests and even holding its own in "cogonales." The fruits, which are about twice the size of a cultivated raspberry, are pinkish red; season, May to June; may be eaten, of course, either raw or cooked.

DECÁY.

This giant creeper of uncertain relationship is found in the dense forests of Cavite Province where it attains a length of 15 to 30 or more meters. In the rainy season it produces heavy clusters of green fruits 2 to 3 centimeters in diameter and 1 to 2 centimeters in length; the very acid juice is used in place of lemon or vinegar with fish and meats.

AYONG BILOG.

Two distinct forms, or probably species, of this cissuslike vine, also native to the Cavite forests, are producers of edible grapelike fruits. The pale rose or pink form has fruits with a sweetish pulp, while the brown or terra-cotta sort has a sour pulp very suitable for jelly.

AYONG LAPAD.

Another thus far unidentified liane, occurring in the Cavite forests, where it rambles about among the tops of the forest trees. In August it bears brownish-red, very sour, grapelike fruits in huge bunches weighing 2 to 3 kilos; these fruits, when cooked and strained to remove seeds and skins, make a very fine, queerly colored jelly.

TIBÍG.

(*Ficus* spp.)

Several varieties of wild fig occurring in the Philippine forests are worthy of cultivation. The fruits, to be sure, are in most cases somewhat small, seldom exceeding 4 centimeters in diameter, but are frequently produced in enormous clusters (50 to 100 in a bunch). These fruits are, of course, borne on the trunk or the larger branches.

The purplish, the whitish, or the green sorts may be used in making a very toothsome jam; a dash of lemon or calamondin (*Citrus mitis*) juice may be used to overcome the heavy sweet-

ness. Most of the varieties bearing edible fruits attain only 4 to 6 meters, while some of the forest species reach a height of 25 meters or more.

DAUAG.

(*Capparis horrida* L.)

A very spiny vine of the Cavite forests. The fruit, attaining a length of 3 to 5 centimeters, invites investigation; at present, however, it is not used by the Filipinos. It is a very close relative of the Spanish caper (a section of the fruit reminding one strongly of the "alcaparrones" of the Spanish canneries). At present the dauag is used chiefly as a source of thorny branches for catching (by the wing-tearing method) the large and very edible fruit bats that ought to learn better than to rob the Filipino farmers' kapok trees on moonlight nights.

BÓBOG.

(*Sterculia fœtida* L.) (Plate II.)

This very widely distributed species is not sufficiently well known as a nut tree. The seed, boiled or roasted, is, so far as we know, perfectly wholesome even when consumed in large quantities. The seed contains a high percentage of oil which can probably be used either for culinary purposes or as an adulterant. It belongs to a perfectly reputable family, being not distantly related to the cacao, from which the world gets its 150 million pesos' worth of cocoa and chocolate each year. Though the wood of this tree is of little value, its quick growth and umbrageous habit render the bóbog a fair sort of shade tree.

Unless the price of vegetable oil goes up considerably more, however, it will probably never pay to cultivate this tree solely for the oil; on the other hand, we see no reason why the Philippine farmer cannot turn an honest penny by the collection of the seeds wherever the tree is plentiful, provided, of course, he can induce the middlemen and merchants to turn the new raw product into cash.

SANTOL.

(*Sandoricum koetjape Merr.*) (Plate III, *a*.)

This is another widely ranging but still insufficiently known fruit tree. The tree itself, belonging to the mahogany family, is an excellent shade tree of the dense-headed type; the old leaves, turning reddish just before falling, recall the autumn foliage colors of the Temperate Zone. The fruit, attaining a diameter of 5 to 7 centimeters, has a leathery, khaki-colored rind inclosing



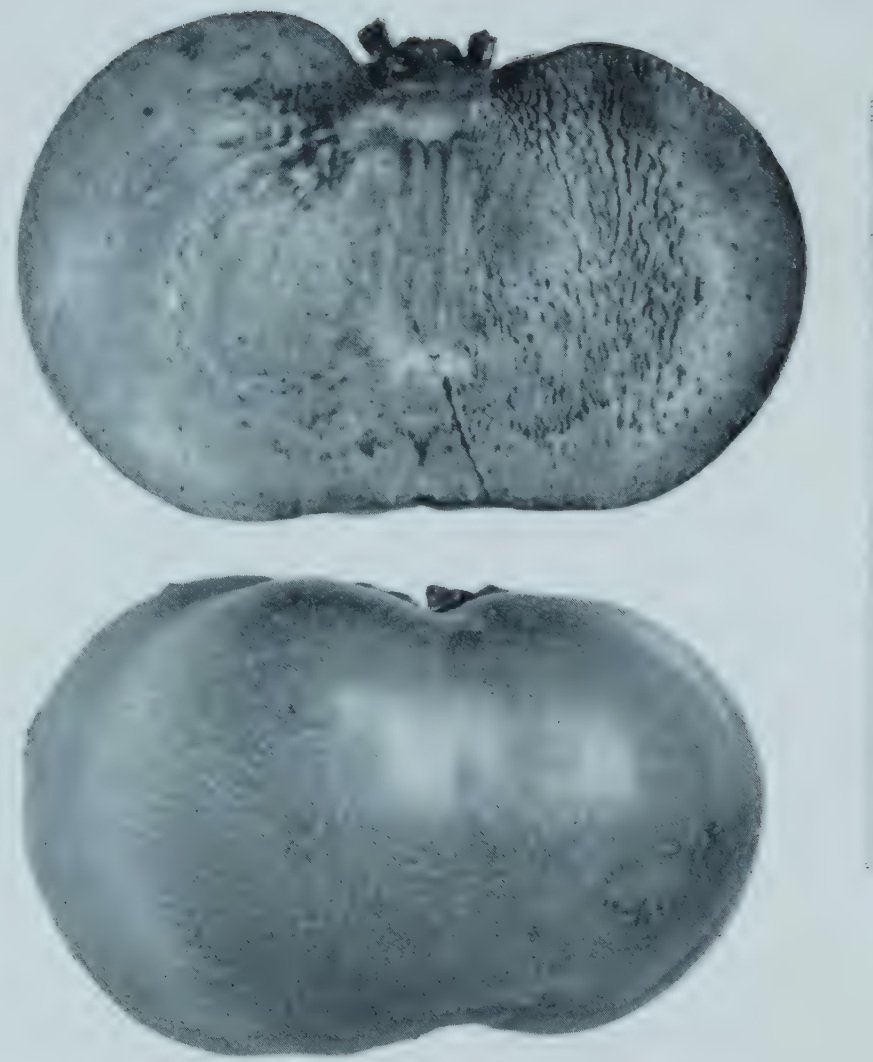
(*a*) Bóbog (*Sterculia fœtida* L.).



(*b*) Bóbog; carpel split open exposing seeds.



(*a*) Sántol (*Sandoricum koetjape* Merr.).



(*b*) Sapote Negro (*Diospyros ebenaster* Retz).



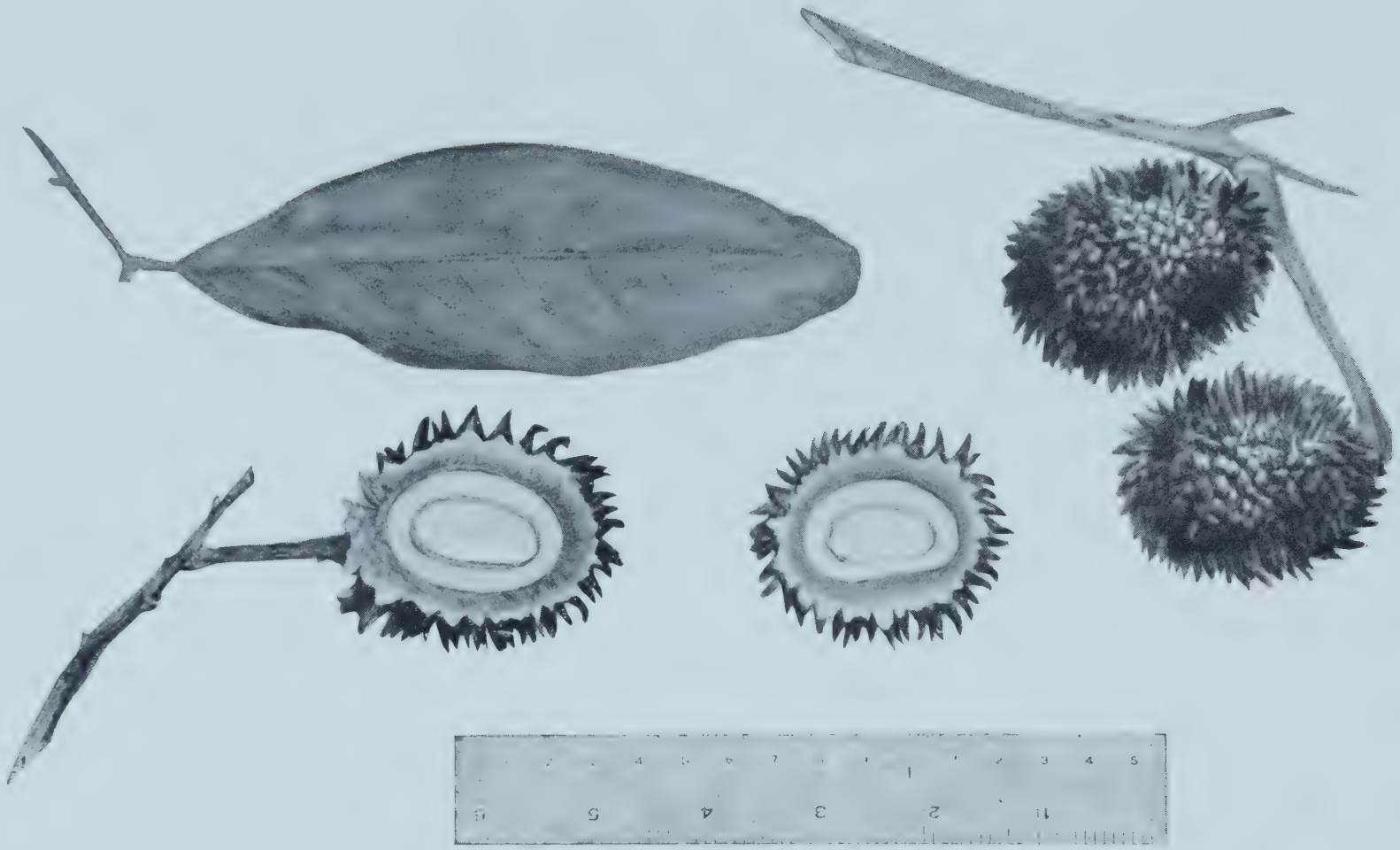
Genipap (*Genipa americana* L.). Young tree at the Lamao Experiment Station.



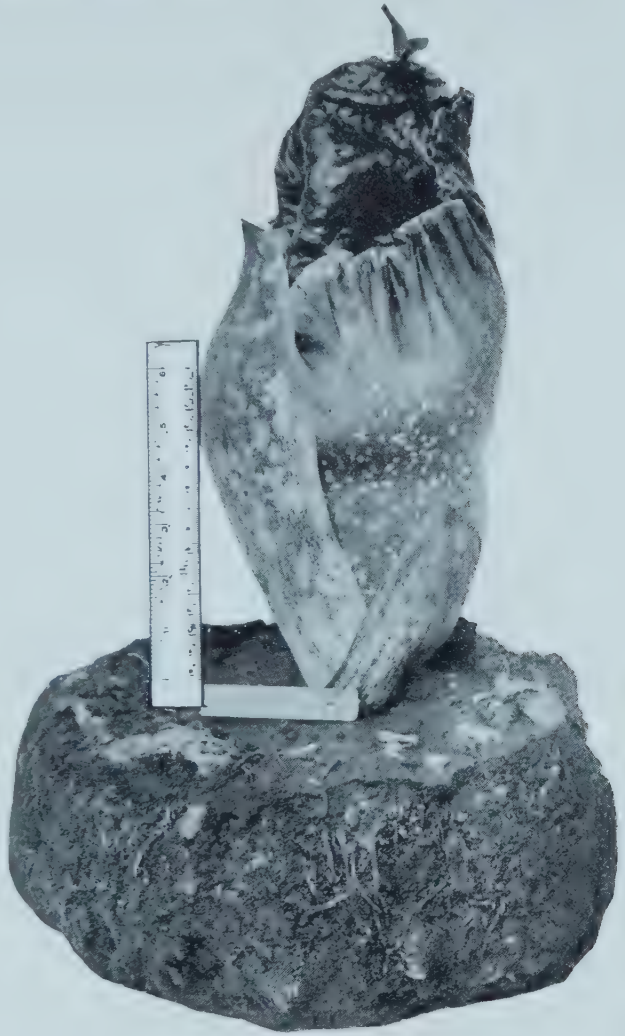
(*a*) Galó; mature specimen; Cavite Province.



(*b*) Galó fruits; husked nuts at top.



Laguan (*Nephelium mutabile* Bl.).



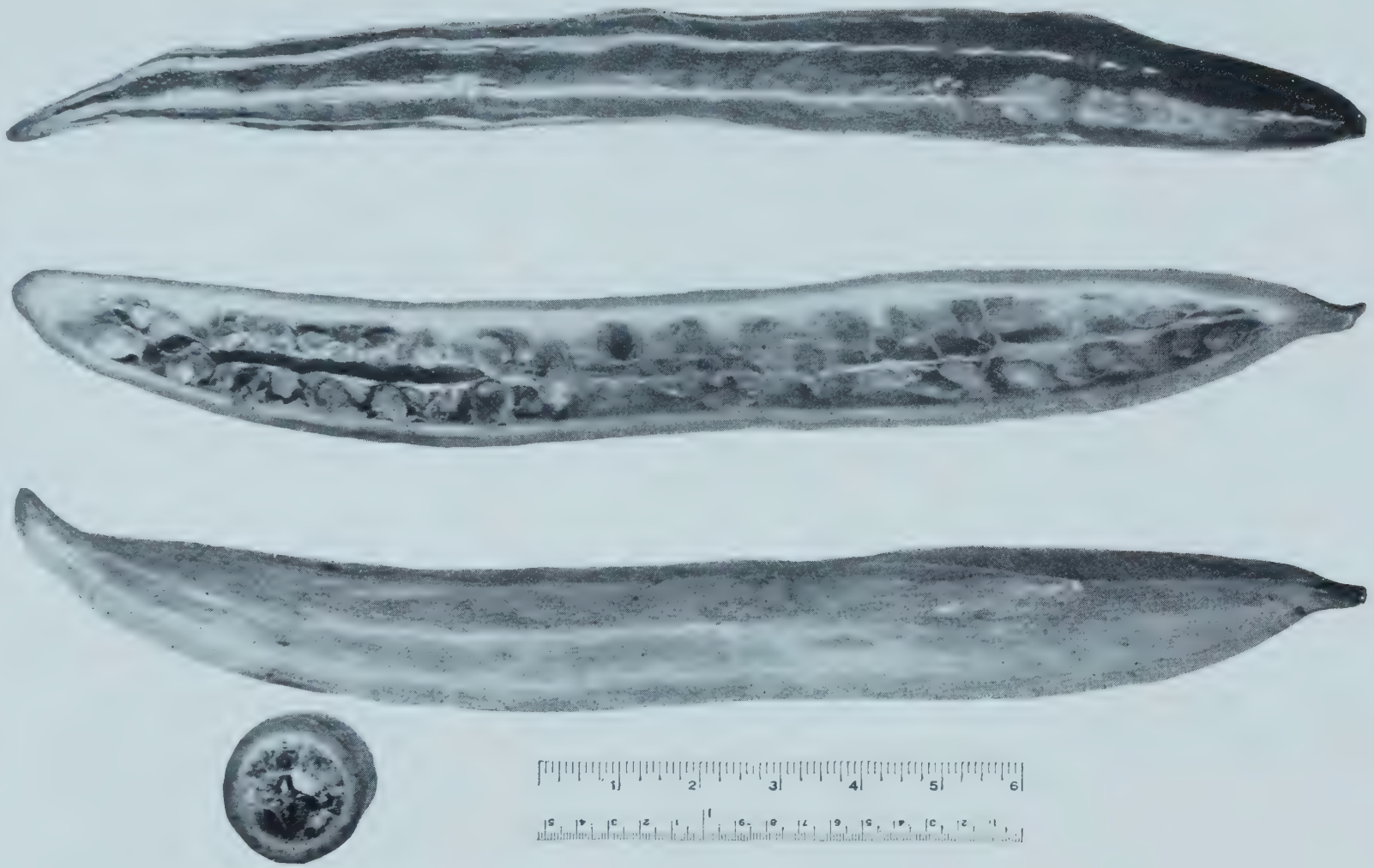
(*a*) Pungápung (*Amorphophallus campanulatus* Blume); corm with flower bud issuing from center.



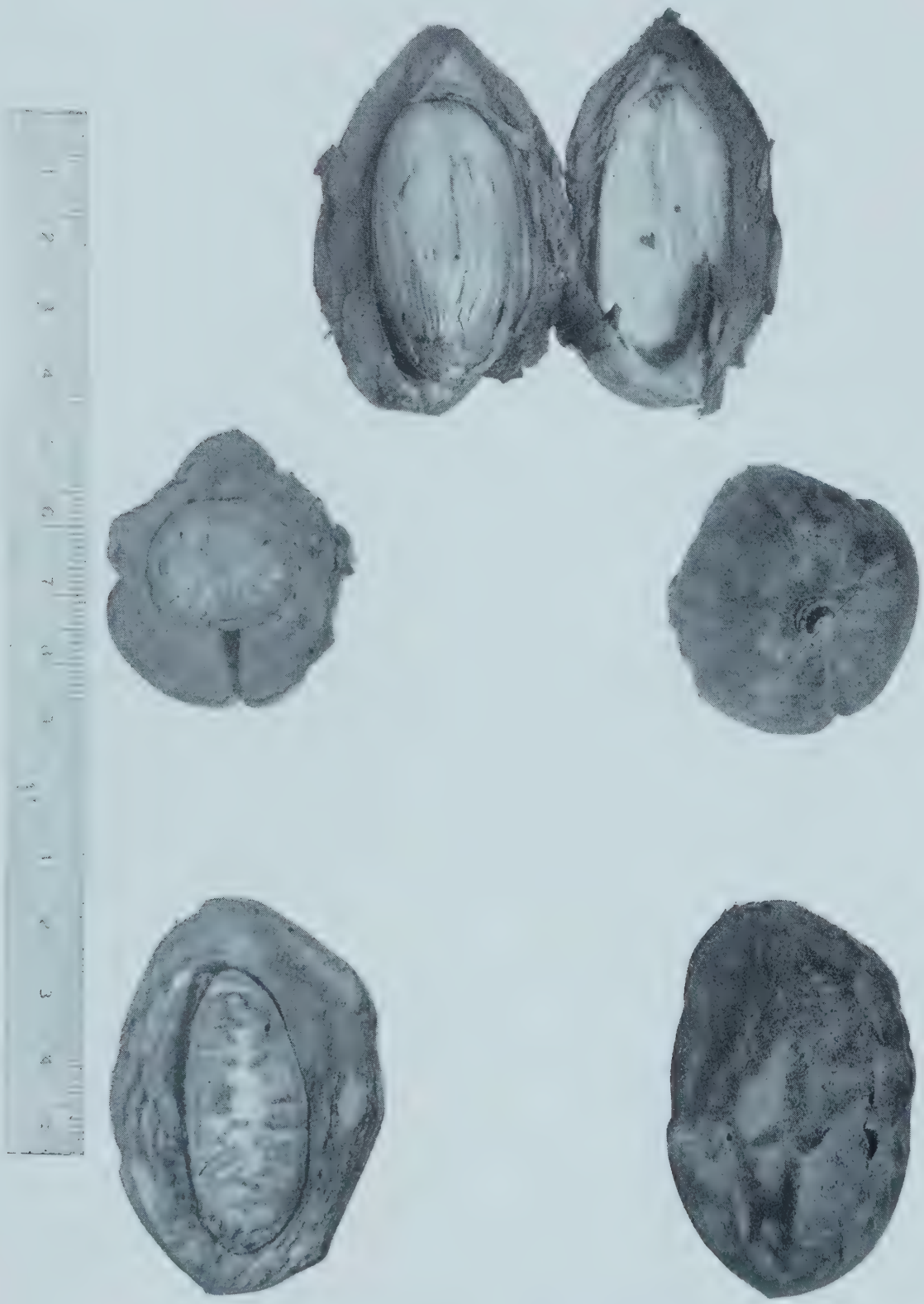
(*b*) Same corm, two weeks later, with fully opened flower; spathe mauve or grayish purple; spadix purple or blackish.



Uay (*Calamus mollis* Blanco).



Pacúpis (*Trichosanthes anguina* L.); short, straight variety.



Alubíhod (*Myristica* sp.); wild nutmeg, Cavite Province.



Chico Mamey (*Lucuma mammosa* Gärtn.). Rare fruit in the Philippine Islands; introduced from tropical America.

semitranslucent, highly aromatic pulp. The thick rind, together with the pulp when cooked, make one of the very best jams the writer has ever tasted; the flavor, or rather flavors, baffle description.

SAPOTE NEGRO.

(*Diospyros ebenaster* Retz.) (Plate III, *b*.)

This is one of the introduced sapotes, rather rare thus far in the Philippines; it occurs widely in nature from Texas to South America. The plentiful pulp is unfortunately of a dull black color; perhaps on account of this and its mawkish sweet, spicy flavor it is often eaten in milk. The pulp makes a fairly good pie or tart and when mixed with lemon juice or some similar acid to counteract its "heaviness' it passes muster as a first-class fruit.

GENIPAP.

(*Genipa americana* L.) (Plate IV.)

For the first time probably in the horticultural history of the Orient this West Indian tree has fruited here. The seeds were sent by the writer from the Porto Rico experiment station in 1903. The trees at the Lamao experiment station now stand some 5 to 7 meters high and seem quite contented.

The plant belongs to the coffee family and, as would be expected, the fruit is quite innocuous. The genipap will probably never be very popular on account of its too strong and peculiar odor, which reminds one of fermenting apples; but as an "ade" fruit it will always have a place in horticulture. Only the pulp about the seeds is used in making the drink, the outer pulp, which separates from the inner mass, being too tough for this purpose.

GALÓ.

(Plate V.)

This recently discovered fruit seems to be endemic to the Province of Cavite where it is used in season to a considerable extent as food. The kernel of the nutlike fruit has a delicious flavor, either raw or cooked, reminding one of sugar-corn, though there is a distinct nutlike taste in addition. The tree producing this new nut attains a height of 4 to 10 meters and prefers the half-open forest of the hills in the interior of the province. The outer portion of the pulpy husk does not change from its dull green color at the time of maturity, June to July. It is not known whether this tree would endure cultivation, but, if so, it

is certainly worthy of a prominent place in every fruit and nut collection of the Tropics. Up to this time the identity of the galó has baffled botanists and horticulturists, but it is hoped that as soon as flowers can be obtained the description can be made. Presumably this is a new species, if not a new genus, of the Philippine flora.

LAGUAN.

(*Nephelium mutabile* Bl.) (Plate VI.)

Of the several species of indigenous Nepheliums, including *N. litchi* Camb., this forest tree of Cavite is one of the most important in the Archipelago. This is one of our most beautiful native fruits; the exterior is a mass of short fleshy spines about 3 to 5 millimeters in length, slightly curved like those of the Rambutan (*N. lappaceum* L.) and the cultivated form of this wild species, the Kapulasan, or Doekoe (*N. mutabile* Bl., vars.) of Malaysia; the color ranges from brilliant scarlet to dark carmine. The pulp itself is very meager considering the bulk of the fruit, most of the interior being taken up by the very large, somewhat flattened seed. The fully matured fruit attains a length of 5 to 7 centimeters by 3 to 4 centimeters in diameter.

This seed, when boiled or roasted, is used like cacao in preparing a very delicious drink, and is used in adulterating cacao in the preparation of chocolate. Quite possibly the roasted seeds could be marketed as a fancy nut in season, or a cocoalike powder could be prepared for use in making a beverage.

The guin-guin, or wild longan (*Euphoria* [*Nephelium*] *longana* Lam.), occurs also in the vicinity of Manila. The sour, pulpy aril is quite edible and may be used in making jelly. A cultivated variety of this species is known from India to southern China, but is rare in this neighborhood.

PALAUAN.

(*Cyrtosperma merkusii* Schott.)

This interesting aroid has the distinction of being the largest cultivated plant of that family in the world. Plate I gives a good idea of the striking luxuriance of the plants under favorable conditions. This plant is cultivated more or less in the Visayas and southern Luzon as a root crop; a closely allied species occurs in Guam, and another, or possibly the same one, is found in Java.

Unfortunately, the coarseness of the texture of the rhizomes, which may weigh up to 25 or more kilos, prohibits their use,

except in case of emergency, for the table; however, when boiled, they make excellent pig feed. It appears the palauan prefers a very moist soil and can be grown to good advantage in the margin of a swamp. The propagation is the same as in the case of the yautía, gabi, and alocasia, i. e., sections of the rhizome bearing dormant eyes, or offsets bearing a few small leaves, may be planted.

PUNGÁPUNG.

(*Amorphophallus campanulatus* Blume.) (Plate VII.)

The huge corms of this aroid, weighing 3 to 6 or more kilos, are harvested in the dry season, cut in thin slices, and dried in the sun. These dried slices are pounded in a wooden mortar until the starchy fecula is broken up into a coarse grayish-brown meal. This meal is then boiled, forming a mush or paste, which is considered very excellent feed for fattening pigs. Individual corms large enough to give one sack of meal are sometimes encountered along the edges of streams or in the rich soil of forest margins. On account of the mechanically poisonous raphides (crystals of calcium oxalate), this giant root crop cannot be used in the raw state; even the wild pig, tantalized by the wholesome-looking bulk of these corms, can do no more than vent his spite by rooting them out of the ground.

A rare sort of salad of delicious flavor is prepared by taking a section, say, 25 centimeters long, at the top of the young petiole just before the blades of the leaf unfold. This cylinder, which may be 4 to 8 centimeters in diameter, is deprived of its outer cuticle—care being taken not to allow the burning sap to get on the fingers—and boiled for a few minutes. This cylinder sliced or diced with onion or other garnish is greatly esteemed.

UAY.

(*Calamus mollis* Blanco.) (Plate VIII.)

One of the several edible-fruited bejucos, or rattans, of the Philippines. This climbing palm occurs rather widely in thickets and forest margins. The fruit has the scaly exterior common to the other species of this large genus; the aromatic, sweetish pulp is, however, rather unusual among the rattans. When not quite ripe there is a slight acridness noticeable in the whitish semitransparent pulp, this being due perhaps to quickly soluble raphides thus somewhat resembling the mechanically poisonous fruits of the Cabonegro Palm (*Arenga saccharifera* Labill.).

PALÁSAN.

(*Calamus albus* Pers.)

Another kind of edible-fruited rattan, the fruits in this case having a shiny yellowish exterior; in size these fruits are 2 to 4 times larger than the uay and of better quality for eating out of hand. This palm occurs along the rivers of Cavite Province where it attains a length of 25 to 50 meters.

It would be, of course, practically impossible to cultivate any species of *Calamus*, but where the fruits are obtainable they constitute a wholesome addition to the list of native fruits.

PACÚPIS, OR SNAKE CUCUMBER.

(*Trichosanthes anguina* L.) (Plate IX.)

This vegetable, which unfortunately is of rather rare occurrence and difficult cultivation in the Philippines, has been grown for ages in India and Malaysia. It exists in two or three varieties, one of which is illustrated in Plate IX. The delicate flavor and semiseedless pulp of the immature fruits render this a first-class salad vegetable. Peeled and boiled, then diced or cut into strips, it excels the string bean. The green and white rind has a distinctive, though hardly pleasant, odor.

ALUBÍHOD, OR TALANG-TALANG.

(*Myristica* sp.) (Plate X.)

This interesting forest tree is nothing more nor less than a wild nutmeg. The seed does not seem to be used by the Filipinos, but is greedily devoured by the wild pigs. It gives three crops per year and, as seen in Plate X, there is a fair amount of mace covering the exterior of the shell; the endosperm resembles that of the true nutmeg in the way of irregularity of coloring and the convolutions.

CHICO MAMEY.

(*Lucuma mammosa* Gaertn.) (Plate XI.)

This splendid old tropical American fruit is deplorably quite rare in the Philippines. When well grown, the tree attains a height of 15 to 25 meters in the West Indies, but it seldom reaches that height here.

The pulp of this exceptionally large fruit is of a deep salmon or reddish orange color and of a very highly aromatic flavor. In fact, its spiciness is too much of a good thing for some connoisseurs.

BUYOC-BUYOC.

(*Trichosanthes* spp.)

Two forms, or species, of this annual cucurbitaceous vine are indigenous in the Cavite jungles. The leaves of these vines are shed during the rainy season and by August and September the striking scarlet or orange fruits are in evidence on the nearly naked vines. One sort has spherical fruits of a rich dark-red color, while another (Buyoc-buyoc-na-dilao) has elliptical fruits of a yellow, turning to an orange-red, shade, sometimes with handsome mottling; the former variety is the size of an ordinary apple, while the latter attains a size of 12 to 14 centimeters in length by 8 to 10 centimeters in diameter. The pulp around the seeds in the center of the fruit is of a dull dark-green shade, while the flesh between the rind and the seed cavity is pale yellow. When half or two-thirds mature the fruits of either, especially of the larger, sort are cooked like summer squash, the rind and seeds being removed. These fruits are among the most beautiful, either as to exterior or interior, to be found in the Philippine Archipelago.

THE PRESENT SYSTEM OF GRADING AND BALING ABACA (MANILA HEMP), ITS DEFECTS, AND REMEDIES THEREFOR.

By M. M. Saleeby, *Chief, Fiber Division.*

Every agricultural industry, whether fiber or otherwise, consists essentially of three distinct but correlated phases, namely, *the agricultural, the manufactural,* and *the commercial.* The first includes all operations connected with planting, cultivating, and harvesting the crop; the second includes the details of the working of the raw product into the various forms suitable for use and also specifies the manner in which the raw product should be prepared and placed on the market;[1] and the third comprises the preparation of the raw product for the manufacturer's use, and includes all transactions which ordinarily take place from the time the product leaves the producer's hand until it is delivered at the factory.

Three classes of people are, therefore, directly concerned in the handling of agricultural products, namely, the *producers,* the *manufacturers,* and the *merchants.* It is only in a very few instances that the third class is superseded by the producer who delivers the raw product to the manufacturer direct. Such instances, however, indicate an intelligent and progressive class of producers, who are financially in a position to do without the middleman and broker.

The agricultural and the manufactural phases of any industry are so closely related that what affects one of necessity affects the other, either for good or for bad. The commercial phase is related to both of the others, and it is the medium by which the raw product is prepared in the form and manner required by the manufacturer and thus transmitted to the latter. Besides the above, the merchants, or middlemen and brokers, are also supposed to interpret to the producers the wishes of the manufacturers with regard to the condition in which the raw product is required. The methods used in the preparation of raw products for the consuming markets differ in number and kind.

[1] Further references to this phase will deal entirely with the second item.

While some entail grading, baling, and marking according to a system or standard, others require nothing more than mere packing.

Theoretically speaking, the destiny of any agricultural industry is shaped primarily by the manufacturers and the producers; in practice, however, the middlemen and brokers have been influencing in several ways the quality of the raw product, the manner of its preparation and export, and the quantities and periods in which it should reach the market, all of which play an important part in the welfare of any agricultural industry.

The welfare of the abacá industry of the Philippines, as well as that of any other industry, will therefore depend upon the proper adjustment of its three phases and upon the mutual coöperation of the three classes concerned. The agricultural, and to some extent the manufactural, phase of the abacá industry of the Philippines has been adequately discussed in previous issues of the Philippine Agricultural Review and in certain other publications of the Bureau of Agriculture, and consequently the producers and manufacturers are, or should be, now sufficiently well informed in all matters pertaining to their respective interests in the industry and to the conditions under which the best results are obtained. It therefore remains for us to discuss at length in this paper the present methods which are used by middlemen and brokers in the preparation of the fiber for the consuming markets, and to suggest improvements along certain lines whereby the interests of the industry in general will be better served.

Before proceeding with the subject proper of this paper it may be interesting and instructive, particularly to those who have made no special study of the subject, to discuss the basis upon which the grading of abacá is made, to enumerate the grades of abacá as they are at present prepared, and to explain the causes which have brought about the present multiplicity of grades.

BASIS OF GRADING.

Color and strength are the qualities which are generally considered in grading abacá. The texture or structure of the fiber is only considered in the lower grades of abacá. In the higher grades it is only considered by the larger and more up-to-date grading establishments. The length is not considered, unless it is decidedly below 1½ meters, and even then many grading establishments do not make any discrimination.

The qualities of the abacá fiber vary according to certain con-

ditions and agencies. The method and degree of cleaning and drying affect its color, strength, and to some extent its texture; the position of the sheath in the stalk affects its color, length, and strength; the variety of the plant from which the fiber is extracted affects its length, strength, and texture; and soil and climatic conditions affect primarily its length and texture.

Any system of grading, in order to be complete and in accordance with the requirements of the consuming market, must include the consideration of the color, strength, length, and texture of the fiber. It is not necessary, however, that variations in the latter two qualities should cause new grades, but they should specify certain types of grades.

COMMERCIAL GRADES.

Strictly speaking, there is no fixed and accepted standard of grades for abacá. The so-called standard names for the commercial grades are used mostly in market quotations and reports, the ordinary transactions between exporters and consumers being carried on by the use of "house marks." These house marks are supposed to be identical with the corresponding grades of the standard, but upon close examination it will be found that this is not the case. In the first place, the so-called standard grades are not fixed and are interpreted differently by different firms; and, in the second place, the "house marks" themselves are not constant, and in many cases each mark varies to such an extent as to overlap a grade either above or below the one it is supposed to represent. The confusion arising from such variation is, of course, very annoying to the buyers, and consequently it is detrimental to the welfare of the industry. To avoid these variations, it is obvious that a fixed and accepted standard must be established, which should be adhered to by all grading establishments.

The following are the commercial grades of abacá as they are generally known in the fiber markets:

1. 300 per cent over good current.
2. 250 per cent over good current.
3. 200 per cent over good current.
4. 150 per cent over good current.
5. 100 per cent over good current.
6. 50 per cent over good current.
7. 25 per cent over good current.
8. Good current.
9. 75 per cent over current.
10. 50 per cent over current or midway.
11. 25 per cent over current.
12. Current, or fair current, U. S.
13. Current, or fair current, U. K.
14. Superior seconds, U. S.
15. Superior seconds, U. K.
16. Good seconds.
17. Fair seconds.
18. Good brown, or good red.
19. Fair brown, or fair red.

The first three are sometimes known collectively as "best marks," "F. E. A. quality," or "superior good current;" and the next three, as "good marks," "F. E. B. quality," or, with the exception of the lowest, also as "superior good current."

CAUSES OF MULTIPLICITY OF ABACÁ GRADES.

To a person who has made no special study of fibers it appears strange that there should be more grades of the abacá fiber than of the remaining leaf (hard) fibers, such as sisal, maguey (cantala), henequen, Mauritius hemp, New Zealand flax, etc. An explanation of the above fact lies in the anatomical structure of those parts of the plants from which the fiber is obtained. In the case of abacá the fiber-yielding portions are the bases, or petioles, of the leaves, which are sheathlike in appearance and are tightly laid one over the other so as to form a solid cylindric mass, which is called the stalk of the plant. The sheaths of every stalk vary in color and size, thus causing corresponding changes in the fiber which they contain.[1] It is generally admitted that the peculiar formation of the sheaths in the abacá stalk is responsible for four to six grades. In the remaining commercial leaf fibers, the fiber is obtained from the leaves proper, which produce fiber somewhat uniform in strength color, and size, providing the leaves are equally matured and developed.

Another important factor which influences the abacá fiber by increasing the number of its commercial grades is the present crude method employed in its extraction and drying. The presence or absence of serrations on the stripping knife as well as the number of such serrations to the centimeter, the adjustment of the knife and block and pressure of the former on the latter, and the skill of the laborer, invariably affect the quality of the fiber extracted. This factor, together with the care or lack of care given to drying the fiber after it has been extracted, gives rise to many grades and types of grades. This is deemed the most important factor making for the present multiplicity of grades.

Still another factor which has recently made for an increase in the number of commercial grades is the lack of uniformity on the part of grading establishments in grading the fiber. As was mentioned before, the buyers often encounter variation in the same grades they receive, and this variation, when it is not

[1] For detailed description of the formation of the abacá stalk see writer's article "Abacá Fiber," Philippine Agricultural Review, Vol. III, No. 6, p. 359.

sufficient to raise or lower the fiber in question by one grade, often leads the two parties concerned in the transaction to a division of the difference. At first, this gave rise to such grades as "25 per cent over good current," "75 per cent over current," and "25 per cent over current;" then later the same circumstances led to a still further division, from which originated such ridiculous grades as "37½ per cent over current," "12½ per cent over good current," and so on. When, with an allowance of 50 per cent over and below certain grades, the majority of the graders do not always obtain uniform classification, it stands to reason that the continuance of such intermediate grades is not a sign of improvement, but merely adds complexity. The alleged belief that such a division of grades has been caused by a demand for it in the consuming markets cannot be sustained. The manufacturers themselves are not yet in accord as to the number of grades required, but it is believed that a somewhat lesser number of grades, specifying the type of the fiber in each grade, will be preferred by the manufacturers.

Market conditions, droughts, typhoons, and the business relations between provincial buyers and producers often influence the quality of the abacá fiber. These agencies, however, have been discussed sufficiently in previous articles and notes in the Philippine Agricultural Review, and a further discussion of them at this time is thus rendered unnecessary.

GRADING THE FIBER.

The causes which have given rise to the multiplicity of the commercial grades of abacá indicate the difficulties which are encountered in grading the fiber. Notwithstanding these difficulties, however, the present methods of grading can be improved so as to reduce to a limited extent the present number of grades, and at the same time obtain better and more uniform grades. Such an improvement can be effected along the following lines:

(1) Though a general supervision is exercised by an expert classifier, yet the actual grading and sorting in every grading establishment is done by ordinary men who have no education nor any particular training other than practice to qualify them for this work. In other words, they belong to the common laboring class who cannot use the judgment and common sense which are continually being required of them. If it is not practicable to employ a better and more intelligent class of men, then the present class should be better supervised, and their

work guided and checked by the preparation of standard specimens which should be continually before their eyes.

(2) In almost every grading establishment all grading is performed inside a large warehouse, where the same fiber is baled and stored. Such places have either insufficient or variable light, or both, thus causing a wide divergence between the apparent and the true color of the fiber. Every person with any experience in this line readily admits that, in order to obtain correct and uniform grading, the fiber must be graded in a regular shed especially constructed for the purpose, to which sufficient light is accessible, and in which the amount of light varies as little as possible.

(3) Often the fiber is delivered at a grading establishment in loosely tied bundles, or hanks, varying in weight from 1 or 2 to 10 or more kilos. The large hanks often contain two or three grades of fiber, and, instead of the hanks being divided, they are each given an average grade and sorted *en masse*. It is true that the producers are to blame for preparing such large hanks, but at the same time it is evident that no uniform grading can be obtained without dividing each hank into as many component parts as there are well-defined grades in it.

(4) In the grades "good current" and below, the fiber is often found to have dingy, or discolored, tips, due to a fault in the stripping knife which causes the dried end of the sheath to slip under the knife, or to a soiling of the ends of the fibers while wet. The extent of discoloration at the tips, or finer ends, of the fiber varies from a few to about 30 or more centimeters. As a rule, very little or no consideration is paid by the majority of graders to such a discoloration. Where this is intense and extensive, the discolored part should be cut off, baled by itself or mixed with the tow, marked "waste," "tow," or some such other mark, and quoted for separately. If this is done by all graders, the tendency will be to discourage its continuance by the producers.

(5) The presence of tow, or broken or netted fine fibers, in the body or the tip of a hank is also another matter which receives little or no attention from the majority of graders. The presence of this tow is due to a lack of adjustment in the stripping knife, especially in cleaning the higher grades. Tow, therefore, is encountered in the grades above "good current," the fiber of which is fine and soft. The objection to the presence of this tow is based on the excessive waste of fiber during the operation of carding at the mill. While it is admitted that

the freeing of the hanks of fiber from any tow is, in some cases, a tedious and rather expensive operation, yet at the same time it is believed that the graders should unite in an attempt to discourage its presence. This might be done in a manner similar to that suggested for getting rid of the dingy tips.

(6) Recently it has been quite frequently brought to the attention of the writer that a very weak and partially disintegrated fiber is being mixed with the grades of abacá below "current." Several specimens of such fiber have been examined and their breaking strain ascertained, and the results showed that this fiber may have been either abacá or pacol (wild species of banana), but in either case it was damaged. Its breaking strain was in most cases about 25 per cent of that of normal abacá fiber and about 50 per cent of that of maguey (cantala) or sisal. Whatever the identity of this fiber may be, mixing it with the commercial grades of abacá is detrimental, and the graders of abacá are urged to take precautions to put a stop to such a practice which without question injures the reputation of our abacá fiber more than any other single factor.

(7) According to the present practice, the only qualities of fiber which are ordinarily considered in grading abacá are color and strength. Size and texture are other qualities which determine to what particular uses a fiber is best adapted. These latter qualities, therefore, though they do not necessarily produce different grades, yet undoubtedly determine the type of a fiber of a certain grade. Two lots of abacá may grade "good current," but the fiber in one may be either longer and coarser or shorter and softer than that in the other. In both cases the grade should remain the same; but, inasmuch as the uses for which these two types of fiber are employed may be different, it would be appropriate to designate them, not by raising or lowering their grade, but by specifying the type. This can be done by adding some mark to the designation of the grade, such as "L," "Sh," "C," "F," "S," for "long," "short," "coarse," "fine," "soft," respectively. Such a designation of the type of a certain grade or grades will enable the consumers to order and obtain the particular kind of fiber which they require.

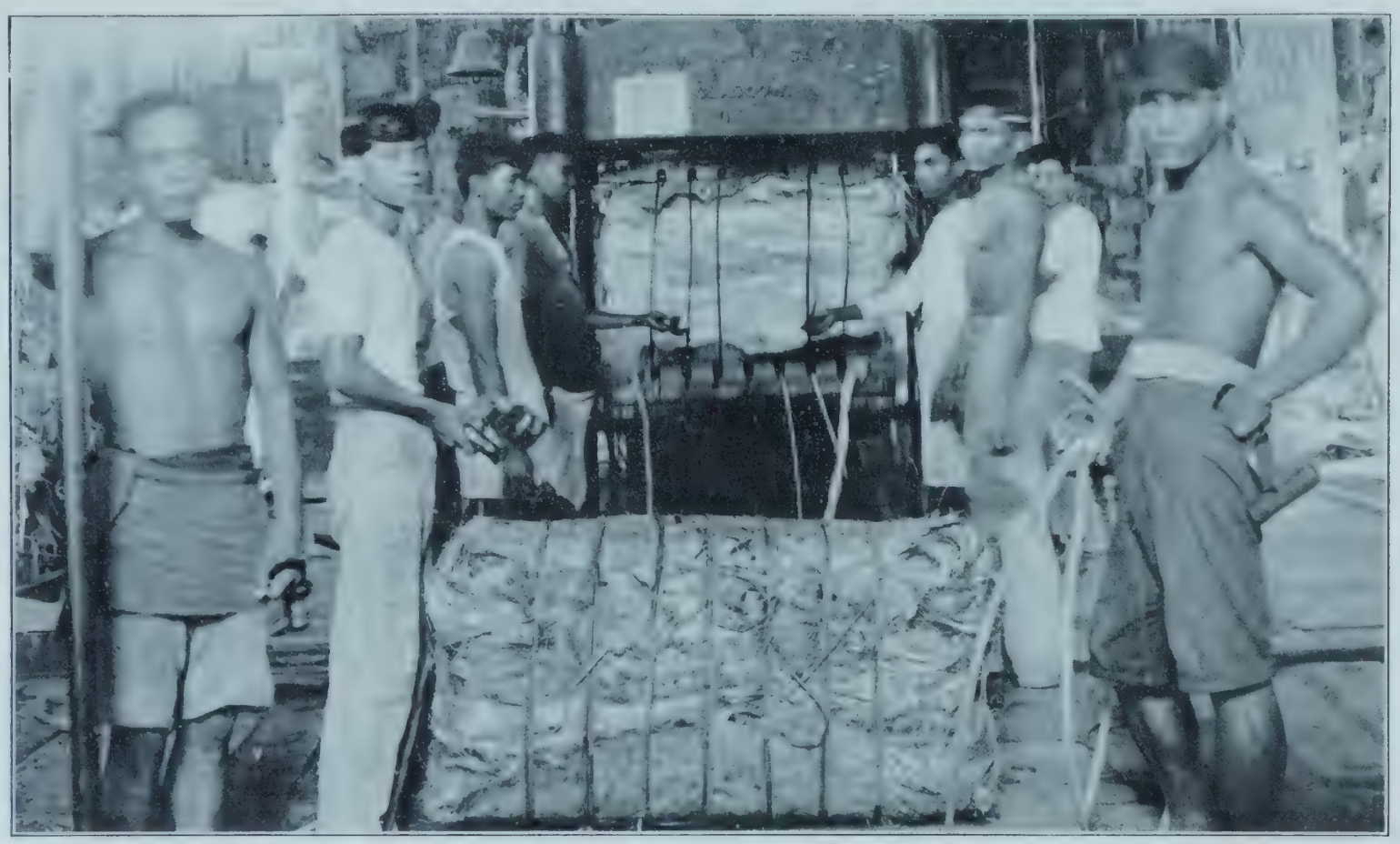
(8) The question of reducing the present number of commercial grades of abacá without interfering with the welfare of the industry is one which requires serious consideration. The manufacturers themselves are at variance regarding this question, and no help from that source can be expected. The writer is of the opinion that all grades designated by a 25 per cent increase over another grade can be done away with without



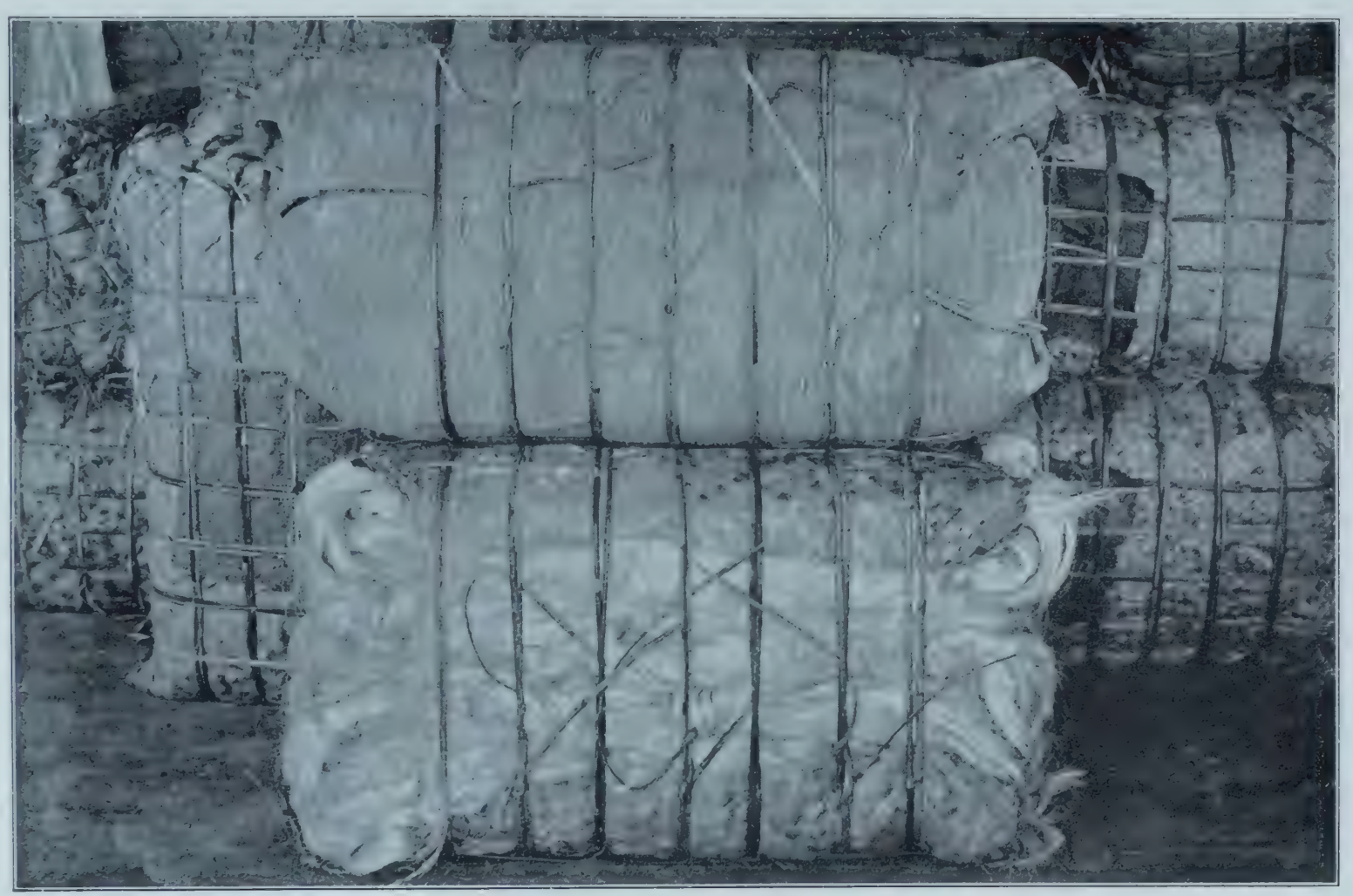
Present method of grading and sorting abacá.



Preparing abacá for pressing.



Present method of pressing and tying abacá bales.



Abacá bales and method of wrapping.

any disturbance to the industry. The grounds for such a belief lie in the fact that neither the so-called standard grades nor the multitude of house marks, which are supposed to conform to the former, are fixed. The variation in the interpretation of a certain grade between two grading establishments is fully as divergent as that between two consecutive grades or marks of the same house. It is admitted, however, that a reduction in the present number of grades may necessitate some change in the standard of certain principal grades. Such a change, if left to the grading establishments themselves, may result in a more complicated system than the present. The Government, therefore, is the only medium by which a new and simple system of grading can be established, and we hope that before long our Government may see its way clear to adjust this important phase of the abacá industry.

BALING THE FIBER.

Not only is the grading of abacá more complex and difficult than that of any other fiber of its class, but its baling also is more difficult. The dimensions of a bale are limited, and the abacá fiber is too long to allow of its adjustment in the bale in as neat a manner as sisal, maguey, or some other leaf fiber. The writer is not aware that any complaints have been made against the present method of baling, except in the case of certain provincial houses. The dimensions of the bale as it is now prepared and the pressure to which the fiber in it is subjected appear to be satisfactory. Notwithstanding the above, however, it is believed that improvement can be effected to advantage with respect to the following points:

(1) In many cases some of the hanks of which a bale is composed are entirely too large to allow of the arrangement of the fiber in a straight and untangled manner. Often parts of the hank fall off in handling during and between the operations of grading and baling and the fiber becomes so tangled as to cause annoyance and waste at the mill. The hanks, therefore, should not exceed a certain weight, say, 2 to 4 kilos, according to the length of the fiber, and should be tied tight enough to hold the fibers together.

(2) The hanks should not be braided at the butt end, as often is the case in the so-called "quilot" grades. It must be borne in mind that the part which is braided has to be cut off by hand and classed as waste at the mill. The loss of that much fiber in waste and the cost of the hand labor expended in cutting the braids should be sufficient reasons to put a stop to this practice.

For practically the same reasons the fiber in the hanks should be baled straight and not twisted upon itself in a manner similar to the twisting of the strands of a rope.

(3) The hanks should be tied at the butt end with strands large enough to hold the fibers together. Such strands are cut off at the mill and classed as waste or strings, and any excess in the size of such strands means excess of waste. In addition, these strands should not be tied too tight or the fiber at that point will be injured.

(4) In arranging the rows of hanks in the bale, the butts and tips should, if possible, alternate. The bending, or doubling, of the hank should be made as near the tip as the length of the fiber allows.

(5) Not only should the fiber in the bale be dry and of uniform classification, but it should also be free from any extraneous matter. Some of the provincial balers are very careless in this respect, and the condition of their bales, when opened, is disgraceful. Leaves, twigs, chips of wood, and sometimes dirt, are often in evidence. These, besides being signs of unwarranted neglect, are bound to cause a prejudice against the quality of the fiber.

(6) It will perhaps be more convenient to reduce the number of bejuco (rattan) bands with which the bale is tied. This can be done by requiring larger strips than the ordinary ones, which shall have both the required strength and the same weight. In this connection may be mentioned the fact that in some instances no canvas is placed on either face of the bale, thus exposing the mark on the burí matting to the danger of being erased. The canvas should never be omitted, and the mark should be printed upon it.

CONCLUSION.

A reform movement in the commercial phase of the abacá industry along the lines suggested in this paper will, it is believed, produce good results. Negligence and waste, not only on the part of the majority of local buyers, but also on the part of the producers, injure the reputation of our fiber and invite competition from other fibers. While it is admitted that in a few of the phases of the problems discussed in this paper a radical improvement may be impracticable, yet a constant effort on the part of local buyers and producers to initiate promptly or gradually the improvements herein referred to is bound to improve the status of our most important export product and result in mutual benefit to the various classes of people interested in its production and exportation.

PLANTING MAIZE.

By H. O. JACOBSON, *Agricultural Inspector.*

Between the tyro who hopefully buries the whole ear and the expert maize grower who sorts the seed kernels to an absolute uniformity in size, there is a considerable variation in methods, yet all successful methods embrace certain important factors, such as the proper time for planting, preparation of seed bed, and depth and spacing of the seed in the soil.

The proper time to plant maize in the Philippines cannot be stated specifically, as is the case in most parts of the United States, for in this latitude and climate conditions are very dissimilar.

It is safe to say that maize may be planted at any date in the year, if the soil is in proper condition, and a crop secured, yet there is a part of the year—the rainy season—which is less suitable for growing the crop.

The maize plant requires not merely light, but actual sunshine in large amounts, as well as heat. In fact, with sufficient soil moisture present it never becomes too hot, even in this climate, for the welfare of maize.

During the months of June, July, August, and September there is usually insufficient sunshine for the best development of the plant. There is also the menace of a destructive typhoon that may greatly injure the growing crop; besides this, the frequent rains prohibit needed cultivation at the proper time and when occurring during the pollination period prevent complete fertilization of the embryo seeds. Altogether, it is hardly worth while to make a commercial planting of maize during these months, although it may be extremely profitable for the market gardener to take a chance at growing a crop for sale as roasting ears.

The earliest date in October or November at which the field can be well prepared is the proper time to plant, and if irrigation is possible any date up to April 15 is suitable. Good maize growers will assure you that no time is proper for planting if

the field is not well and carefully prepared. Since the outcome of the crop is influenced by the early growth of the plants, and the early growth of the plants is largely dependent on the physical condition of the soil, it becomes imperative that the seed bed be made fairly deep, free from lumps, and moderately compact. This early cultivation also destroys countless weeds, and good tilth is thus more easily and cheaply acquired than by later cultivation after the crop is planted.

A hard and fast rule for the proper depth at which to plant cannot be given. Seed should be placed deeper in loose sandy soils than in dense clay soils. When digging into the ground the depth at which the moist soil is encountered is the proper depth to place the seeds. The more shallowly the seed may be planted with safety, the better it is for the plant.

The newly sprouted plant is unable to utilize the plant food in the soil until its plumule, or primary leaves, encounters the sunshine, therefore it expends the starchy part of the seed kernel in extending the young stem through the soil into the air and sunlight. If the seed be planted too deeply the plumule may fail to reach the surface at all or, if it does, the plant begins its new functions in a greatly exhausted condition.

Shallow planting husbands the primary food resources of the plant and provides it with a more vigorous start in life. Too shallow planting is also to be avoided because of the possible lack of sufficient moisture to germinate the seed.

Whether the seed is planted by means of a stick, hoe, or hand planter, the seed should not be covered by loose soil, but should be firmed by stepping on the hill. This compacts the soil surrounding the seed so as to bring the moisture in contact with it and promotes more rapid germination. Maize-planting machines firm the soil by the wheels passing over the seed.

The most important matter in planting is to place the rows and the plants in the rows a sufficient distance apart so as to allow the maximum development for each individual, with due regard to average results.

If the plants are placed excessively far apart, maximum development will undoubtedly be attained, but at a loss of yield per hectare. This occurs because there are not a sufficient number of plants on a given area to utilize all the available plant food and water. On the other hand, if the plants are placed too close, few if any develop fully because there is insufficient plant food to support this large number.

The aim of the maize grower is to raise just enough plants

per hectare to utilize the available plant food and water—no more and no less. And since no one else knows better the productivity of a given soil than the man who tills it, the problem of spacing the plants is one that must be solved by the planter.

A very common criticism of the methods employed by the Filipino maize grower is directed at the practice of growing altogether too many plants on a given area.

A hectare of land contains 10,000 square meters, or an area 100 meters long by 100 meters wide. If the rows are placed 50 centimeters apart and the plants 10 centimeters apart in the row, we have 200 rows with 1,000 plants per row, making a total of 200,000 plants, a tremendous number, and this is not an unusual example of maize planting as practiced here. If each plant produced a medium-sized ear weighing 0.1 kilo, the yield would be 20,000 kilos, or 666 cavans, of maize per hectare. Everybody knows that such an enormous yield is absolutely impossible. It is too fantastic even for the tyro to consider seriously.

It is the function of a maize plant to produce grain, and in a carefully handled field of maize at least 95 per cent of the plants will bear ears. Placing the rows 1 meter apart and allowing three plants to the meter in the row we have 30,000 plants on 1 hectare. If 95 per cent of the plants produce ears averaging 0.1 kilo each, there will be a total yield of 2,850 kilos per hectare, or 95 cavans. An ear weighing only 0.1 kilo is a pitifully small thing and certainly not one that would be selected for seed. The average ear of Moro maize weighs 0.25 to 0.35 kilo. It is not theory, but actual fact, that a yield twice as large can be secured with no more plants per hectare.

A maize plant has only one mission in life—to reproduce itself by maturing its seed. Therefore, each plant extends its root system in all directions, competing with all the other neighboring plants for the food and water in the soil. If there is not enough food and water for all, none will attain their full development, although the stronger and more vigorous plants will secure a somewhat larger share.

An argument frequently advanced to justify the close planting of maize is the old-fashioned custom still in vogue of selling the maize by number instead of by weight. However, this argument falls flat when one enters the market to buy, as small ears may be had for 20 to 40 centavos per 100 and large ears may cost ₱1 to ₱1.50 per 100.

There is no common-sense argument to support the practice of planting more than 30,000 plants of maize per hectare, and in

many places no more than 20,000 plants per hectare should be allowed to grow.

If the soil is not very fertile, far better results will be secured with the smaller than with the larger number.

The maize plant should be regarded as an individual that must be both well fed and well cared for and that will give a recompense in the form of grain in exact proportion to the provision that is made for it. There is no safe way to cheat Nature, and the maize grower must remember he is dealing with her.

NOTES ON AGRICULTURAL PESTS.

By D. B. Mackie, *Assistant Entomologist.*

The seasons from July, 1911, to July, 1912, were extremely abnormal. The rainy season commenced early and the precipitation was unusually heavy. The typhoon flood of July covered practically the entire central part of Luzon, doing irreparable damage in many districts. Heavy rains continued during the month of August, causing further local inundations. In September, 1911, the time when the wet season should have been at its height, the rains, except for a few intermittent showers, virtually ceased. This unusual circumstance was followed by a drought lasting seven months, making it practically impossible to raise anything for lack of water. This period lasted till July, 1912, when normal conditions reasserted themselves. As might be anticipated, these abnormal seasons produced conditions influencing in a large degree the numbers of several of our more important agricultural pests.

The relative importance of the more serious pests is as follows: Locusts, rats, and swarming caterpillars.

Locusts.—The influence of climatic conditions on the numbers of this pest can best be realized from the extent of the invasion during the latter part of 1911 as compared with that of 1912. During the year 1911 the locust reports for the calendar year, while showing scattered swarms in many provinces, failed to excite public comment.

Following the protracted drought the numbers of this species increased at an alarming rate, especially in the Visayas. There appeared to be two large centers of distribution: (1) The uncultivated lands of Agusan and (2) the large unoccupied grass lands of Bohol. In the former district the pest developed and spread to the Provinces of Misamis and Surigao. From the latter it invaded Cebu and Negros. This first invasion did not affect the Island of Luzon, giving rise to the belief that this island would not be subjected to other than local invasion.

The ensuing months revealed the fallacy of this belief, however. In May of the present year the northern invasion began. Swarms developed in the uncultivated lands of northern Tayabas and Isabela, migrated west, and virtually overran the Provinces of Nueva Ecija, Nueva Vizcaya, Bulacan, Rizal, Laguna, and Tayabas. From these provinces the Provinces of Tarlac, Pangasinan, Pampanga, Bataan, Cavite, and Batangas were invaded. The influence of the drought upon the increase of this pest is shown by reports of locust infestation from 30 provinces the year following the drought, as compared with but 7 reports of invasion received the year before.

Rats.—Climatic influences have had a beneficial effect on the numbers of this pest. During the early part of 1911 numerous reports were received by the Bureau detailing enormous damage to sugar cane and rice, especially in Pampanga, Bulacan, Nueva Ecija, and Tarlac. The heavy rains accompanying the typhoon of July inundated the greater part of the cane and rice lands and drowned out by far the larger part of the pest in these provinces, so that, except in a few isolated districts where the lands are high and were not inundated, the pest is now a negligible quantity.

Swarming caterpillars.—Climatic conditions have caused an increase in numbers in several species of Noctuid caterpillars in much the same way that it has locusts. Before the drought only one local outbreak of this nature had been reported and investigation showed that the caterpillars were heavily parasitized.

Toward the end of the drought extensive damage from these pests was reported from 17 provinces. So serious did the infestation become that it was necessary to ship quantities of poison to the worst infested districts. With the return of the rains, conditions relative to this pest are reverting to normal.

Coconut weevil.—The habits of these insects are such that meteorological changes do not exert any great influence on their numbers, yet investigations made from time to time show an increased area of infestation.

This pest is conceded by the coconut growers of all coconut-producing countries to be the most dangerous of those affecting the coconut palm.

Due to a habit of spending the greater part of its life within the trunk of the tree, its attacks are seldom noticed until it is too late to apply remedial measures. Therefore, the only means of controlling this pest is to cut down, and either bury, burn,

or submerge in water the trunks of all trees which show signs of infestation. Planters unfamiliar with the depredations hesitate to apply such radical treatment to their groves, and also allow fallen trees, etc., to remain, thereby furnishing breeding grounds for the pest. Two years ago this pest was reported only from Mindanao, though in all probability it was present in other districts, yet evidently in insufficient numbers to cause any great concern.

During the past fiscal year reports of its destructiveness were received from the following provinces: Tayabas, Oriental Negros, Misamis, and Moro. The planters of this latter province, realizing the seriousness of the pest, have enacted legislation making it compulsory to destroy all trees infested with weevils.

Rice stem borer.—All rice planters are more or less familiar with the depredations of this pest, which, like the coconut weevil, fails to reveal its presence before having caused considerable damage. Infested plants are rendered noticeable by bleached white heads, which form a strong contrast to those bearing fruit.

The status of this pest seems to remain about the same.

The different methods of harvesting the rice crop in a large measure influence the numbers of this pest in various provinces. It has been noticed that in provinces where it is customary to harvest the entire plant, and later burn the straw, the pest is far less numerous than in those provinces where only the heads are harvested. The reason for this is obvious, as in districts where the plants are "headed" the borers remain undisturbed and upon arriving at maturity issue from the stems.

Miscellaneous pests.—Two new pests have been reported. The first, evidently a tip borer, caused local damage during February and March, 1913, to young cane in northern Negros. The insects responsible were small moths which, during the larval stage, live in the heart of the small shoots. The resultant injury is not always fatal to the plant, since new shoots usually develop after the first attack.

A field of young cane infested with this pest is readily detected by the dead terminal shoots turning brownish or yellow. An experiment with an ordinary lantern suspended over a basin containing water and a small amount of petroleum resulted in a catch of 561 individuals in one night.

The second pest was reported as defoliating the coconut trees at San Pablo. Investigation of the outbreaks showed that the trouble was caused by a large yellowish caterpillar which is the larva of a brownish butterfly. This is the first time this

species has ever been reported as causing damage, the adult butterflies seeming to be quite rare. The outbreak is local and conditions will, in all probability, adjust themselves during the present rainy season. According to reports from San Pablo, the species in question is most active in that region during January and February.

The coconut white fly [1] has been reported from Misamis. This is the first report of the presence of this newly discovered species outside of Oriental Negros.

Other minor pests have been called to the attention of the Bureau from time to time, but few have been of more than local importance.

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[1] Philippine Agricultural Review, Vol. V, No. 3, March, 1912.

CURRENT NOTES—OCTOBER.

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

LEVANTINE ORANGES.

It is not generally known that the Levant produces a very large amount of fruit, especially citrus and semitropical sorts, such as apricots, figs, grapes, etc., but it is a fact that the region about Damascus is really one of the most remarkable fruit countries of the world. For several years large quantities of oranges and other fruits have been exported in the "off season" to western Europe from Jaffa, Tripoli, and Beirut. It seems that both the soil and the climate are precisely right for the production of a very highly flavored, richly colored orange, and the "Sidon Oval Blood" is considered one of the very best varieties in the world.

According to the Daily Consular and Trade Reports one firm in Liverpool, England, is importing about 1 million boxes from the Palestine district each season, and statistics show that the port of Jaffa alone ships some 30 thousand tons of oranges per annum.

Two varieties of high merit in the United States are the Joppa and the Jaffa.

BANANA DISEASES.

In tropical America great interest is centering on the diseases which have for the last six or eight years been rampant in banana plantations. A recent number (Vol. II, No. 6) of the bulletin of the Jamaica department of agriculture contains several excellent articles on this subject and in our opinion these are the best that have yet appeared on the mycology of banana plantations. Instead of the trouble being due to any one species of fungus or bacterium as previously believed, it is now fairly certain that there are three, if not four, district fungi and possibly one or two species of bacteria that are etiological factors.

Mr. S. F. Ashby recognizes in Jamaica the banana disease (which has been so destructive in Costa Rica and Panama and probably occurs throughout tropical America), the black-spot

disease, the Bonnygate disease, or Jamaica wilt, several kinds of "blackhead" diseases, dry rot of the bulb, a Marasmius rot attacking the outside of the stem, and the "heart-leaf" disease.

In Surinam, or Dutch Guiana, according to A. W. Drost, it appears there is still another variety (*"Leptospora musæ"*) of the Panama disease.

The disease which appeared two years ago among bananas at the Lamao experiment station has been checked, if not eradicated, there being no evidence now of its presence at that station; several hundred "ponos," or hills, of bananas had to be sacrificed, however, to cheeck the spread of the disease. This trouble seems to be slightly different from any of the tropical American banana diseases. It does not appear to do any serious amount of injury to bananas in the provinces.

STILL MORE NEW COCONUT RIVALS.

The oil and soap syndicates are looking for new ways and means of getting around the gradually rising price of copra. Not satisfied with the oil palm of West Africa (a matter of tremendous importance when we consider the practically unlimited supply obtainable under favorable conditions), their attention is now being turned to a similar palm in the West Indies, the Corozo, or Grugru. The seeds of this palm are somewhat larger than those of the West African oil palm, but the shells can be cracked in the nut-cracking machines now being made by a firm in Liverpool for the West Coast trade.

The oil content of the West Indian is about the same as that of the West African nut, but the oil is a little softer, that is, there is less solid "tallow" at ordinary temperatures in the case of the former. There are large areas in Porto Rico, Santo Domingo, Cuba, and several of the British West India Islands which can supply hundreds, if not thousands, of tons of Grugru nuts annually. The shells should be removed, of course, before shipping, just as the Lumbang, or Biao, nuts are handled in the Philippines.

Still another tropical American oil nut is the Cohune. This palm, ranging from Mexico to Brazil, bears heavy crops of nuts somewhat resembling the Grugru, but having in some cases two seeds instead of one in each fruit. The fat content (71 per cent or more) is rather higher than in the coconut. The new nut-cracking machine can also be adapted to this nut, all of which indirectly makes against the fullest profits of the coconut growers.

THE "BETTER FARMING" TRAIN.

Anent the recent interest displayed in the Manila Railway's agricultural demonstration coach may be mentioned the fact that Canada has extended the same idea (which has, of course, been common for several years in the United States) by taking along with the crop car a *stock* car. In one of the coaches in the Ontario government's "better farming" train, according to the Daily Consular and Trade Reports of the United States Department of Commerce, there will be shown typical specimens of draft horses, beef and dairy cattle, swine, sheep, and poultry. No matter what branch of agriculture, then, any given individual of the audience may be interested in, he will find something to learn and to discuss first-hand with the experts accompanying the train.

Will the time not come when a stock car will also be necessary in the railway demonstration work of this Bureau in the Philippines?

FARM COLONIES IN BRAZIL.

Now that the whole world is awake to the tremendously increased cost of living in congested centers, several governments are turning their attention to "farm colonies." There are still many millions of perfectly good hectares whereon thrifty farmers could realize splendid profits, but for various reasons some of the best farming districts of the world are still left unsettled.

The Brazilian Railway Company has a prosperous colony of 80 houses at Carambahy, north of Pontegrossa. This settlement, called, of course, a "fazenda," possesses pedigreed breeding animals and is making great strides in the manufacture of butter and cheese. It is expected that colonists from Holland will be brought over to assist in the establishment of a genuine Dutch-cheese industry. Already some 200 kilos of first-class cheese are produced weekly, finding a ready market in Curitiba, Pontegrossa, and the flourishing city of São Paulo.

AN EAST AFRICAN EXPOSITION.

About April, 1914, there will be held in Dar-es-Salaam, German East Africa, an international agricultural exposition. The principal industry of German East Africa is farming and stock raising, with fiber growing a close second. Coffee and rubber have been strongly encouraged by the colonial government, but

since Ceará rubber was put before Pará, and considering the fact that fungus disease is rampant on the wild coffees of that region, the results of the governmental support of these industries is awaited with much interest. The exposition, while it probably cannot be heavily patronized by oriental countries, will be of great importance to the East African countries which are, as the whole world now knows, forging ahead rapidly in the line of modern agriculture.

FRENCH INDO CHINA RICE CROP.

According to the Daily Consular and Trade Reports of the United States Department of Commerce, the exports of rice for the coming season in Indo China are estimated at 1,200,000 tons. The rice crop (cleaned product) of the Philippines last season was some 325,000 tons, or about one-fourth the export of our next neighbor to the west.

MARGARINE CHANGES.

According to the Daily Consular and Trade Reports it appears that a remarkable change has taken place in the margarine industry of Denmark. A few years ago about three-fourths of the raw materials used in the manufacture of margarine in that country consisted of fatty substances of animals, but at present the proportion is reversed, so that only 30 per cent of the constituents are animal tallows while 70 per cent are vegetable tallows and oils. It is believed that this change has been gradually brought about through the increased value of live stock; however, it must be admitted that the price of vegetable fatty substances has also increased, especially during the last five years.

There are now 27 factories in Denmark producing about 40 thousand tons of artificial butter per year. The rapidly increasing per capita consumption of margarine in Europe is predicated by the cheapness and healthfulness of this article as compared with animal butters.

DIKA BUTTER.

One by one the mysterious old jungles of Africa are surrendering their secrets, although the end is not yet and may never be. Of the making of new butters there also seems to be no end. The world is much wrought up over the subject of edible oils and vegetable tallows.

A new West African tree (*Irvingia gaboniensis*), according to the Daily Consular and Trade Reports, is now called upon to supply the general public with a new *orange-colored tallow*. The seeds of this tree are said to contain 67 per cent of grease, copra moderately dried containing about 65 to 67 per cent. Dika butter will come in very handy for the oleomargarine manufacturers, who are, of course, very anxious to get a coloring substance which is harmless, cheap, and unchangeable.

There are at least three other important West African vegetable butters, but it seems the Dika will outrank them, especially if it can be obtained in a dependable supply. It is said to be better in some respects than cocoa butter, which is, translated, the high-priced tallow obtained from cacao seeds.

Manketti nuts, also, will be heard from later in the way of new African oils; these are said to be eaten by the natives (in German Southwest Africa); a trial shipment has been made to Europe.

THE TEXAS SCHOOL OF ECONOMICS.

A 20 million peso endowment rice institute has just opened at Houston, Texas. The rice industry of the southwestern United States has grown to such tremendous proportions that it is now necessary that the Government, or at least the separate States, should take a hand in the matter, especially along lines of the more scientific and technical sides of the industry. The new institute will be fitted with special laboratories for physical, chemical, and biological investigations, and it will also have an instruction section for the application of these sciences to the agronomic and commercial sides of the question.

HIDES FROM SOUTH CHINA.

The quarantine regulations of the Philippines would not obviously affect the price of hides in the Yangtze Valley, but such is the fact, according to the Daily Consular and Trade Reports. It appears that about 3,800 pieces of salted oxhides per month are marketed in Hongkong, about 800 of these being from the local slaughterhouses.

The supply of Yangtze hides is said to be increasing, one reason being the "increased use of beef as food by the natives and another the difficulty of profitably disposing of the cattle from the districts named because of the quarantine restrictions in the Philippines." Large quantities of goat and carabao skins are included with the oxhides in the exports.

NOTES BY H. O. JACOBSON, *Agricultural Inspector.*

DEPARTMENT OF AGRICULTURE IN THE MOVING-PICTURE BUSINESS.

According to an article appearing recently in The Country Gentleman, the United States Department of Agriculture is preparing to use moving pictures as a means for educating the people in the matter of how and why they are spending 50 million pesos annually in teaching the farming public modern methods and improved technic in agricultural practice.

The Missouri attitude of "show me" is credited with being responsible for the move to meet the insistent demand for practicable demonstration of new ideas and great hopes are being entertained for the ultimate success of this innovation.

It is planned to release films of a general character through the regular exchanges thereby reaching a large percentage of the people living in cities and towns and educating them to the point where they will have an intelligent idea of standard products and the methods by which they are secured, thus establishing a more harmonious basis on which to bring the producer and consumer together. Other films will be exhibited in the demonstration and extension work and will be of a more specific nature particularly interesting to the producer.

That a picture conveys a more graphic and intelligible impression than the most detailed verbal description has long been recognized; furthermore, the picture speaks in a universal language.

The last-mentioned feature has a particular application in this country where as yet no common language obtains.

Compare, for example, the efforts of an English-speaking demonstrator in Batangas trying to tell the assembled audience through interpreters of the best methods of growing oranges, spraying, grafting, etc., with running off a reel or two of special films graphically showing the entire process.

RICE CULTURE IN JAPAN.

According to the statistical report of the Japanese bureau of agriculture, the rice fields are leased to tenants at an average rental of ₱138.28 per hectare. The landlord pays a land tax, however, of ₱36.27 and has other expenses which must be met amounting to ₱8.50, making a net income to the landlord of ₱93.51.

The average gross returns for a crop of paddy is placed at

₱271.81 per hectare, of which the tenant receives ₱133.53. For upland rice the figures are about 50 per cent lower.

The average gross return per hectare for rice in the Philippines is ₱49.18; for the Province of Nueva Ecija it is ₱90.

While the report does not state definitely whether the returns are for the year or for one crop only, there is ample food for thought afforded by this comparison.

Japan does not afford such remarkably favorable natural conditions for rice growing that the difference may be attributed solely to such causes. The difference must be in the methods employed and particularly in the men who apply those methods.

It appears that there must be a considerable field here for improvement, both on the part of tenants as well as landlords, before it can be safely said that we know all about rice.

TEMPERATURE AND RAINFALL FOR AGRICULTURAL DISTRICTS IN THE PHILIPPINES.

By the DIRECTOR OF THE WEATHER BUREAU.

JULY, 1913.

[Temperature and total rainfall for twenty-four hours beginning at 6 a. m. each day.]

Date.	Abacá (Manila hemp).				Sugar, Iloilo.		Rice, Tarlac.		Tobacco.			
	Albay.		Tacloban.						Aparri.		S. Fernando.	
	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.
	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.
1	29	-------	26.7	-------	26.3	3	29	-------	28.7	-------	26.8	-------
2	28.4	-------	26.8	-------	27	8.6	27.1	-------	28.4	-------	27.3	-------
3	28	7.9	26.6	2.5	26.8	-------	29.3	1.8	28.7	-------	27	-------
4	28.2	2.5	26.7	9.7	27.1	-------	27.9	-------	29	-------	27.2	-------
5	27.6	1.3	26.4	12.7	27.7	-------	29.5	18	28.7	1.3	27.2	-------
6	27.3	-------	27	-------	25.9	18.8	28	-------	29.4	-------	27.2	17
7	27.6	1	27.6	.8	26.8	1.3	28.7	-------	29.3	-------	27.4	-------
8	27.8	7.1	26.6	4.8	27.7	-------	28.8	-------	28.8	-------	25.7	10.2
9	27	-------	26.9	.3	27.2	-------	30	2	28.8	-------	27.4	3.6
10	26.6	5.6	25.8	1.5	27.2	-------	29.7	42.2	27.4	1.3	27.4	3.8
11	27	-------	27.5	-------	27.6	-------	28.8	1	27.8	-------	27.4	56.9
12	27.7	-------	27.5	9.7	26.8	-------	27.8	.8	28.5	-------	28	10.4
13	28	-------	27.6	9.2	26.8	-------	29.1	1.8	27.6	-------	27.9	10.4
14	26.8	95.1	24.8	244.3	25.3	44.5	29	.8	28.6	-------	27	11.7
15	25.6	57	24.5	27.3	25.4	45.7	29.4	16.5	29.4	1.3	28	-------
16	25	62.6	27	9.1	26.5	37.4	27.3	7.4	27.4	38.5	29.1	-------
17	27.2	4.1	27.7	-------	27.8	19	27	3	27.2	-------	27.8	33.7
18	27.9	4.3	29.3	-------	27	14.2	26.4	33.1	28.6	-------	26.2	75.2
19	27.6	5.6	29.8	-------	27.6	15	26.4	14	29.1	-------	24.8	68.9
20	27.6	1.3	29.6	-------	28.3	6.9	26.5	56.9	29.4	-------	25.6	6.9
21	26.8	2	28.9	-------	27.7	15	26.3	16.3	28	2.5	24.9	7.4
22	26.9	4.1	27.2	5.6	25.8	19.2	26.1	26.7	27.3	4.1	26.9	24.4
23	26.5	6.4	26.8	6.9	24.9	142.9	26.4	16	27.3	-------	27.3	31.5
24	26.4	2	27.3	1.3	25.9	9.2	25.5	31.8	27.3	4.6	25.6	4
25	27.3	-------	28.1	-------	27	26.4	26.4	28	26.6	24.5	25.8	6.8
26	27.8	-------	27.9	-------	26.8	6.3	27	6.3	27.6	-------	28.2	2
27	27.2	20	27	4.3	27.2	2.8	25.2	39.3	27.5	1	28.4	2
28	25.4	28.9	26.6	5.9	26	13.7	25.4	22.3	25.4	89.7	25.8	121.9
29	26	24.5	28.2	-------	27.3	33.1	23.3	85.1	25.5	49.6	23.9	300.5
30	27.2	1.3	29	-------	27.3	13.2	24.9	8.4	26	-------	24.8	18.5
31	27.6	-------	28.8	-------	26.5	21.8	26	15.2	27.6	-------	26.8	8.6

PLATE I.



Mungo, seven weeks after planting; grown as a cover crop in citrus plantation, at the Lamao experiment station. Note evenness of stand, abundance of pods, and weed-killing efficiency.

EDITORIAL.

RECENT PLANT INTRODUCTIONS.

After very discouraging and almost entirely fruitless efforts extending over a period of some ten years, the famous seedless pomelos of Siam have finally been brought into cultivation outside that community. Several efforts have been made, not only on the part of the Government of the Philippine Islands, but also by the United States Government, toward getting in genuine plants or budwood of these fruits. A little propagation material of these fruits was received by this Bureau about one year ago, but not until this month has there been in evidence a good quantity of budwood of the genuine varieties personally taken by a competent expert from trees in situ in the plantations of central Siam.

About five distinct types of these very valuable fruits were collected by an employee of the division of horticulture during September; a report upon the trip is being prepared for a later issue of the REVIEW. It is believed that these varieties of pomelo will revolutionize the so-called "grapefruit" industry of the United States as soon as they can be worked up for general distribution in that country.

Besides propagating material of these Siamese citrus fruits a very large collection (including some 40 names) of Siamese bananas was brought back by the above-mentioned collector; and while en route to Siam he also made important collections of economics, thanks to the kind courtesy of the respective officials in Hongkong, Saigon, and Singapore. It is believed that this trip marks an important step in the progress of the horticultural work of this Bureau.

THE POTENTIAL VALUE OF PARASITES.

For a long time scientists have understood that without certain forces, such as parasites, predators, meteorological agents, etc., practically any species of animal or plant might in a comparatively short space of time overrun its habitat and become a menace to the existence of other living species in that region. In fact, we have now come to realize that it requires only a very slight force upon either side of the "natural balance," as it has come to be called, to produce changes amounting to millions of pesos in importance (as profit or loss in agri-

culture) as affected by these good or bad factors in man's struggle for existence; and, by the same token, agriculturists now realize principles which a few decades ago were disregarded but are now widely known to be of the utmost importance to the *output of the land,* broadly speaking.

For instance, although the chance of ultimate benefit may be really very slight, scientific agriculturists the world over are now willing to spend vast sums of money in the effort to find some factor which more or less artificially they may put into operation to turn the tide or assist in upsetting the balance of certain natural forces *in their favor.* Although there have been very few cases in the history of agronomy or horticulture wherein it can be clearly proved that man has with definite design successfully assisted beneficial animal species or inhibited those which are known to cause heavy losses in agriculture, there is just enough hope in this line to furnish good excuses for outfitting exploring expeditions into the far corners of the earth with the purpose of discovering beneficial species, and transplanting them, so to speak, where they are obviously needed in the war against pests and diseases.

To take a concrete example, it requires no effort of imagination to appreciate the feelings of the economic entomologist when, after grave difficulties have been experienced in obtaining a natural parasite of a very destructive fruit fly, and after carefully rearing the parasitic insect up to the point where it can be liberated in large numbers to attack the host species (the fruit fly), he sees numerous active female parasites searching with quivering antennæ for the precise spot in the soil where the pupæ of the pest are hidden, then digging away the earth particles until they can deposit the eggs which mean certain death to the host pupæ and thereby the mitigation of the evil, if not the absolute control of the pest, which before the arrival of the friendly parasite had come near to wrecking an industry involving millions of capital.

Parasitology has come to be a prominent branch of modern agriculture. It behooves every planter and every stock raiser, whether he produces cane, rice, maize, fruit, or live stock, to study this science assiduously. The more the planter knows about parasitism facts, even though in most cases parasites are partial failures, the better chance he has of success in his profession. Besides the material side of the question, there is probably no more interesting phase of outdoor biology, once the agriculturist grasps the principles and potential possibilities of this wonderful new line of practical science.

BUREAU OF AGRICULTURE CIRCULAR No. 25—CULTURAL DIRECTIONS FOR VEGETABLES AND FLOWERS.

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CULTURAL DIRECTIONS FOR VEGETABLES AND FLOWERS.

By P. J. WESTER, *Horticulturist.*

LOCATION.

In locating and making a vegetable or flower garden the following points should be kept in mind: (*a*) That the prospective garden must be well sheltered from strong winds; (*b*) that the land must be well drained; (*c*) that the soil must be rich in humus, light, and easily worked.

If not naturally protected by the house and vegetation, a windbreak may be constructed by the planting of shrubs or small trees around the garden, yet it should be well exposed to the sun. Well-drained land is absolutely essential; if the site for the garden is not well drained naturally, drainage must be provided for by ditching.

PREPARATION OF THE GARDEN.

Spade or plow the ground well to a depth of not less than 20 centimeters; break up all lumps, remove all trash, and level the land with a garden rake. If the soil is not naturally fertile and is heavy, stiff, and inclined to bake, it may be improved by adding to it stable manure or decaying vegetable matter and a little sand, which substances should be thoroughly worked into the soil. Do not attempt to work the soil when it is wet and soggy after a heavy rain. The soil is about right for working and planting when it *crumbles and falls apart* under moderate pressure in the hand; the land is then in good condition for planting seed direct in the soil or for the setting out of plants from the seed bed.

SEED BED.

Many plants succeed better if the seed is sown in a seed bed, where, during the early stages of their growth, they may be protected better from the hot rays of the sun, heavy rains, and noxious insects, than if the seed were sown in the open ground. If the seed bed is prepared in the garden a small bamboo frame should be erected over it, and a roof made of palm leaves or cogon grass.

SEED BOXES.

If insects, particularly ants, are troublesome, it is best to sow the seeds in shallow boxes, commonly called "flats." Make the flats about 10 centimeters deep, and in nailing them allow enough space between the bottom boards (3 to 5 millimeters) to provide for drainage; a number of small holes bored in the bottom of the flat will also serve to carry off any surplus water.

Cover the bottom of the flat with a layer (about 2 centimeters deep) of coal ashes, gravel, or small stones, and then fill the flat to within a centimeter of the top with fine, rich, preferably *sandy* loam; heavy, *sticky* loam is not suitable. Firm the soil moderately before sowing the seed.

Sow the seeds in rows about 4 to 5 centimeters apart, from 3 to 10 millimeters apart in the row, depending upon the size of seed and vigor of the plant. Cover the seed slightly with a layer of soil—of the thickness of the seed planted, is a good rule—and firm the soil well and then water thoroughly.

After having planted the seed do not allow the soil in the flat to dry out, or the seed will not germinate; nor, on the other hand, should it be watered so often that the soil is kept continually wet and soggy—for in this case the seed decays or the young plants are likely to rot off at the surface of the ground. With many plants this stage is the most critical in their development and many are lost by excessive watering.

After the plants have appeared above ground, a good rule is to allow the soil to become so dry that the plants are on the point of wilting and *then water the flat thoroughly* so that the water penetrates to the bottom. Frequent and shallow watering is very pernicious in that it encourages a root system near the surface of the soil and prevents the development of deep-going roots, and thus stunts the plants.

Weeds should, of course, be pulled out whenever they appear.

If ants and other crawling insects are troublesome, place the seed boxes on a table made of bamboo with the legs standing in tin cans filled with water.



Lyon bean (*Mucuna lyonii* Merr.), three months after planting; grown as a cover crop to kill weeds and grass and to enrich the soil; Lamao experiment station. Note bamboo tripods for supporting seed-bearing vines.



Cowpea, "New Era" variety; ten weeks after planting; grown as a "blanket," or cover crop to enrich soil in citrus plantation at the Lamao experiment station. Note dense stand, heavy seed production, and vigor of plants.

TRANSPLANTING.

When the young plants begin to crowd each other transplant them into other boxes prepared as heretofore described, about 3 to 5 centimeters apart. Before removing the plants the seed flat should be watered thoroughly and the flat into which the plants are transplanted should be well watered after the operation.

PLANTING IN THE OPEN.

When the plants are 6 to 12 or more centimeters tall, depending upon the kind, they are ready to set out in their permanent position. It is well to place the plant box in the full sunlight a few days prior to setting out the plants in order to accustom them to the change. The transplanting of the plants from the seed bed or flat to the garden is best accomplished during a cloudy day or late in the afternoon. Cut off about one-half of the leaves. Disturb the roots as little as possible, and firm the soil well around them when the plants are set out.

In the case of some plants, such as beans, peas, radishes, carrots, maize, cucumbers, melons, okra, etc., it is better to plant the seed direct in the field, as they do not transplant well. If for any reason, however, it is desired not to do so, make small baskets of banana leaves or stalks about 8 centimeters in diameter, fill them with earth, and place them side by side in a flat. When the plants are large enough to set out in the field, water the plants thoroughly, carefully remove the basket, and set out each plant with its ball of earth *without breaking it.*

SAVING SEEDS.

Vegetable seed deteriorates so rapidly in the Philippines at sea level that it is usually not advisable to collect seed for planting another year, the better plan being to obtain fresh, imported seed for each season. With flowers, however, the seeds may be kept for planting another year. Save the seeds from the best plants when they are ripe, spread them out to dry on a paper *in the shade,* and when well dried place them in a tightly corked bottle. It is well to remember that seeds do not, as a rule, retain their vitality long in the Philippines, and that the sooner they are planted the better.

PLANTING DISTANCES FOR VEGETABLES.

No general rule can be laid down as to distances at which to plant, as this depends upon the character of the plant, and, to some extent, upon the fertility of the soil. The following table

indicates the approximate distances that should be used for the most common vegetables:

Table showing at what distances the most common vegetables should be planted in the field and garden.

Name of plant.	Distance in row.	Distance between rows.
Beans:		
Lima (hills)	1 meter	1.5 meters.
String (seeds)	10 centimeters	50 centimeters.
Beet	Drill	35 centimeters.
Cabbage	50 centimeters	75 centimeters.
Carrot	Drill	30 centimeters.
Cucumber (hills)	1.5 meters	2 meters.
Eggplant (hills)	60 centimeters	75 centimeters.
Garlic	5 centimeters	25 centimeters.
Lettuce	15 centimeters	15 to 30 centimeters.
Maize (hills)	1 meter	1 meter.
Melon	1.5 meters	1.5 meters.
Melon, water	2 meters	2 meters.
Okra	50 centimeters	1 meter.
Onion	Drill	30 centimeters.
Parsley	do	25 centimeters.
Peas	do	50 to 90 centimeters.
Pepper	40 centimeters	75 centimeters.
Radish	Drill	20 centimeters.
Roselle (hills)	1 to 2.5 meters	1 to 2.5 meters.
Squash	1.5 meters	2 meters.
Sweet potato	40 centimeters	1 meter.
Tomato	60 to 75 centimeters	Do.
Turnip	10 centimeters	50 centimeters.

HERBACEOUS ORNAMENTALS.

The following is a list of annual and perennial flowering herbaceous plants that will succeed in the Philippines with ordinary care, and whose propagation is not difficult:

Amaranthus (seed).
Angelonia grandiflora (cuttings and roots).
Calliopsis (seed).
Canna (roots).
Celosia, or cockscomb (seed).
Coleus (seed and cuttings).
Coreopsis (seed).
Cosmos (seed).
Dahlia, annual (seed).
Gaillardia (seed).
Gomphrena (seed).
Helianthus, or sunflower (seed).
Helichrysum (seed).
Iberis, or candytuft (seed).
Impatiens balsamina, or balsam (seed).
Mirabilis jalapa, or four o'clock (seed).
Nasturtium (seed).
Phlox (seed).
Roselle (seed).
Salvia splendens (seed and cuttings).
Tagetes, or French marigold (seed).
Verbena (seed and cuttings).
Vinca, or periwinkle (seed).
Zinnia (seed).

Fresh-water sand is the most suitable medium for the rooting of cuttings; if this is not obtainable, use light, sandy loam. Put the sand or soil in a flat as already described under seed boxes and set in a well-sheltered, shady place. Make the cuttings from 5 to 7 centimeters long, and trim off about two-thirds of the leaves; then insert the cuttings in the rooting medium to about

one-half or a little more of their length, pack the soil or sand well around them, and water thoroughly. When the cuttings have rooted, transplant them into a shaded bed with good garden soil and when they have made good vigorous plants transplant them to the flower bed.

INSECT CONTROL.

Most insects that attack plants in the seedling stage devour the foliage and tender shoots. They are easily controlled by dusting the plants with a mixture of Paris green and air-slaked lime, dry road dust, or fine soil. For this purpose mix 25 grams Paris green to 1 kilo of the diluting substance and stir together the two ingredients thoroughly. Place the mixture in a bag of cotton cloth and shake it over the plants until they are covered with a thin layer of dust. This is best done in the morning while the plants are still wet with dew. Do not apply the mixture thickly as it may injure the plants.

Cucumbers, squash, melons, eggplant, and okra are frequently troubled by aphids, which are small green or brownish sucking insects. These are readily destroyed by the application of tobacco dust. The aphids usually attach themselves to the under side of the leaves and in order to be effective the tobacco dust should therefore be thrown on the plants *from the side and upwards.* Apply the tobacco dust early in the morning while the plants are wet with dew. Repeat the application at intervals of two or three days until the insects have been eradicated.

For other insect pests and their control see Circular No. 12.

Remember that Paris green is a dangerous poison and therefore should never be placed where it is accessible to children or animals.

THE PHILIPPINE LOCUST (*Pachytylus migratoroides*, R. & F.); NATURAL INFLUENCES AFFECTING ITS PROPAGATION AND DISTRIBUTION.

By D. B. MACKIE, *Assistant Entomologist.*

In devising remedies for any pest the essential things are a complete knowledge of its habits and a full understanding of the conditions under which it develops. We know that all forms of life, especially those still in a state of nature undisturbed by man's influence, are subject to certain checks which tend to prevent the undue increase of any species and thus maintain a "balance of life."

As the conditions which govern this balance are extremely complex it is often difficult to understand the causes which lead to the results. It is well known, however, that the natural increase of almost any insect species would be very large if the restraining checks were removed.

In order to realize the influence exerted by these checks let us consider what the rate of increase in the common migratory locust would be if not inhabited by natural agencies: Assuming that each female locust lays 60 eggs of which 30 are females, it follows that if each of these 30 pairs reproduces in the same ratio, the progeny of one locust at the end of one year, or the third generation, would be 54,000, of which 27,000 would be females and the next generation would contain 1,620,000 individuals, or enough to make up a fair-sized "swarm."

A mature locust weighs approximately 3 grams; the progeny of one locust in the fourth generation would be nearly 5 tons of locusts. As each locust consumes approximately 300 times its own weight in food, the progeny of one locust in the fourth generation would consume some 1,500 tons of vegetation which, in the case of young maize, cane, or rice, would make a few fields at least *look rather bare.*

Even admitting the above to be overestimated by 50 per cent, it can be readily imagined what the progeny of one of these vast swarms, which sometimes appear, would be if allowed to repro-

duce quite free from all natural checks; and when we consider these figures it is impossible not to realize the great influence that must, in almost every case, be exerted by nature in holding the balance against this normal ratio.

Generally speaking, the forces which operate for or against any species may be stated as climate, food supply, and enemies.

CLIMATE.

Under this heading may be included such checks as temperature, wind, rain, and drought.

Climatic influences exert the greatest checks on locusts, since all forms of insect life are more or less sensitive to them.

Temperature.—While the element of temperature in many countries exerts a powerful influence on locusts by causing them to hibernate for extended periods, yet in a country like the Philippines where the weather is never cold enough to cause them to hibernate, it is not of great economic importance.

Winds.—Winds are a very important factor, especially in locust distribution and control.

With a moderate wind swarms are often enabled to make long sustained flights, even crossing from island to island, as for instance from Cebu to Negros. In this way island provinces that have been free of the pest may suddenly become infested from some province 100 or 200 kilometers distant by the opportune occurrence of a favorable wind coming at a time when the swarms are migrating.

As a general rule, high winds tend to keep locusts near the ground and to prevent extended flights, and severe winds often work great havoc with locusts swarms and at times completely annihilate them.

On two occasions cases like this have been noted, the first occurring in August, 1913. A swarm, flying from Bohol to Cebu, encountered a contrary wind, and, unable to continue against it, was forced to settle on the water and was drowned; for some days afterward the sea was completely covered with a brown crust or scum of these insects, those which were not eaten by fishes being washed ashore on the coast of Bohol where a windrow of dead locusts, nearly a meter high and a kilometer long, was finally deposited; the stench from this rotting mass made it almost impossible to stay in that vicinity.

A similar instance is recorded of a swarm of locusts which on or about May 20, 1913, started from the Island of Tablas, flying west in the direction of Mindoro; about half way to their destination contrary winds were met which forced them to alight

on the sea, nearly the entire swarm being destroyed; for days after this, the beach in the vicinity of Concepcion, on the Island of Maestro del Campo, was deeply covered with dead locusts.

Rains.—The influence of rain is, in importance, about equal to that of winds. As in the case of high winds, locusts seldom fly during rains. When these two phenomena are combined in the form of a typhoon, the results are often disastrous to the swarm, many locusts being killed in large numbers by the vegetation being whipped about by the high wind, and also large numbers are drowned while the wings of the adult locusts are often torn to such an extent that further flight is impossible. When the latter occurrence takes place near the time of oviposition the gravid females are forced to lay their eggs on unsuitable ground which results in a very low percentage of them hatching.

Continued rains often produce floods which are of great importance as locust destroyers. The greatest efficiency in this connection is reached when large areas on which locusts have oviposited become flooded and quantities of silt are deposited over the eggs which effectually prevents the hoppers from emerging. It has also been observed, especially in the Province of Pangasinan, that wherever the eggs have been inundated for seven or more days a large proportion of them have been found to be dead and more or less decayed, this being especially true when incubation was advanced and the embryos were about to emerge.

Drought.—Drought seems to exert a powerful influence in the increase of the pest and it generally happens that a protracted drought will be followed by a period of heavy infestation. The effect of the continued dry weather is not so much of direct influence upon the locusts themselves, but it allows them to increase by removing the conditions which are favorable to the development of natural enemies; in other words, very dry weather is inimical to locust parasites.

Drought may also induce migrations due to lack of the proper food in a given locality.

FOOD SUPPLY.

As previously stated, the food supply of any insect in nature is largely determined by climatic conditions.

A lack of food might cause the migratory instinct to assert itself and the swarms to seek more congenial feeding grounds. Even if the food were adequate to sustain the locusts, their vitality might become lowered so that any other adverse factor would tend to decrease their numbers. Man has, to a certain degree, upset the balance of nature. His clearings are pushed

farther and farther into waste lands, or locust zones, and he produces under artificial conditions crops which furnish the locusts with abundant food at a time when it may be most needed. In cultivation not only are large areas devoted to the same crop, but the plants are grown at seasons when food for the locusts is likely to be scarce on account of the burning over of cogonales, for example; this is especially true of those crops grown under irrigation.

ENEMIES.

Unfortunately very little time has been available to properly study this phase of the work; the influences which are herewith mentioned are only such as have been observed by the author while engaged in the field in the more important work of organizing the field forces.

Roughly speaking, locust enemies may be divided, according to their importance, into three classes: (1) Predators, (2) parasites, (3) diseases.

PREDATORS.

This class may be divided into five groups according to their importance: *Avian* (birds); *Mammalian* (animals); *Piscean* (fishes); and *Reptilian* (lizards, snakes, etc.).

Birds.—There are no natural enemies which attack the locust so persistently in all stages as birds. They often congregate where the locust swarms are and remain for days or weeks at the swarm eating their fill as often as they desire. Their importance as locust exterminators can not be too strongly emphasized. Unfortunately, many of our most persistent locust feeders are not wary in their habits and are ruthlessly snared whenever chance offers. Investigation of the value of birds as locust feeders are limited to cases where individuals have been taken and their stomach contents examined.

Twenty-four species of locust-eating birds have been identified, in the following families:

Turnicidæ (1).
Coracidæ (1).
Ardeidæ (2).
Falconidæ (3).
Artamidæ (1).
Phasianidæ (2).
Meropidæ (2).
Alcedinidæ (4).
Corvidæ (1).
Sylvidæ (2).
Fringillidæ (2).
Anatidæ (2).
Cuculidæ (1).

These species represent only a small number of the birds which have been observed but not taken for identification.

To this list may be added domestic poultry, all kinds of which feed with avidity on the pest at all stages.

Mammalian.—Bats and certain rodents, especially the field rats, mice, and shrews, devour considerable quantities of locusts. Also some of the large mammals, such as wild pigs, monkeys, etc., capture and destroy quite a number of locusts when a swarm visits their neighborhood. This is especially true of the wild pigs which have been noted, particularly in Mindanao, as devouring large numbers of immature locusts.

Reptilian.—Lizards and frogs of various kinds—and there are many—are almost entirely insectivorous and destroy large numbers of both the mature and young locusts.

Most of the small snakes are insectivorous, and when locusts are present feed upon them.

Piscean.—Various fish undoubtedly kill a certain amount of locusts, especially when the swarms (of hoppers) attempt to cross rivers or when migrating (as fliers) they are forced to settle upon the sea on account of contrary winds.

Predatory insects.—This class of enemies preys almost entirely on the immature insects and eggs, and includes Robber Flies (Asilidæ), Digger Wasps (Scoliidæ), Assassin Bugs (Reduviidæ), Tiger Beetles (Cicindelidæ), Ants (Formicidæ), and Mantis (Mantidæ).

Mites, scorpions, and centipedes might be added to this list, though they are not, strictly speaking, insects.

Ants are in all probability the most important of the predatory insects which attack locusts. They devour the pest in all stages. The small species, especially when fields in which locusts have oviposited have been plowed, destroy immense numbers of the eggs.

Observation of one species of these ants, believed to be *Solenopsis geminata,* was made at Bais, Oriental Negros.. The locusts had laid eggs in a field planted with cane, and a few days later the field was plowed. In a surprisingly short time myriads of these small ants were noted feeding upon the locust eggs; in some instances the eggs were bitten into and the contents eaten, and in others the eggs were carried off to the adjacent nests. An examination of one of these nests showed the remains of several locust eggs. These and similar species attack and kill the hoppers, especially the very young ones and any that may be injured or weak.

The large red ants which build paper-like nests in trees and bushes have also been observed carrying the young hoppers up the tree trunks to the nest.

Predatory wasps (Scoliidæ).—A number of species of this

family capture locusts to provision their nests, and in some countries are an important factor in controlling the pest.

Robber flies (*Asilidæ*).—These are very powerful flies which catch and devour other insects by sucking their juices. They are often numerous about the swarms of newly hatched locusts and undoubtedly destroy many.

Predatory Orthoptera (*Mantidæ*), *Hemiptera* (*Reduviidæ*), *and Coleoptera* (*Cicindelidæ.*)—Under these heads are the Assassin Bugs and the Mantis and Tiger Beetles.

All members of these families are predaceous and feed on various insects. While not of great economic importance, they do destroy considerable numbers of the hoppers, especially the young.

While not true insects, the following orders are in most cases included by the layman in this group: Scorpions, spiders, mites, and centipedes. With the exception of some mites, these, like the foregoing, are predaceous in their habits. Though they are not specific locust feeders, yet, with the exception of mites, they destroy many immature insects.

PARASITES.

In view of the very important part played by parasites in the control of insect outbreaks attention is naturally drawn to the possible parasites of the species under consideration.

Unfortunately very little time has been available for investigation along this line due to the press of routine work, though several parasites have been noted and some reared.

In reviewing the subject of parasitism it is evident that a parasite of the eggs of the locust that would act before the locusts could hatch would be the most effective. It is equally evident that parasites attacking the winged locust after it has done most of its damage are of lesser value.

Observations have thus far revealed six species which parasitize the plague locust, which, in order of importance, are as follows: Flies (3 species), nematode worms (2 species), and mites.

Flies.—The females deposit eggs or sometimes maggots upon the living locusts, usually one egg to each hopper. These make their way into the body cavity of the host where they feed on the soft tissues and do not attack the vital parts till they are fully developed, after which they work out of the locust and crawl into the ground to pupate, leaving the locust an empty shell.

Three families of this order, many of which are possible locust

parasites, are present in the Philippines. They are: (1) Tachinidæ, (2) Sarcophagidæ, (3) Dexidæ.

Individuals of the first two groups have been reared; the latter have merely been noted in the vicinity of swarms, but have never been "bred out."

Entomologists of other countries report that the tachinids confine their operations in most cases to the winged locusts. It is yet early to state positively whether the Philippine forms conform to this habit or oviposit in both stages, as sufficient time has not been available to determine this.

The sarcophagids are known to parasitize both the mature and young locusts. The family is a large one and well represented in the Philippines.

The first specimens of parasite locust flies reared were from locusts taken at Cabanatuan, Nueva Ecija. Since then numbers of them have been bred from locusts from other districts. The flies which emerged were a common species fairly abundant around stables and known to oviposit on various kinds of matter.

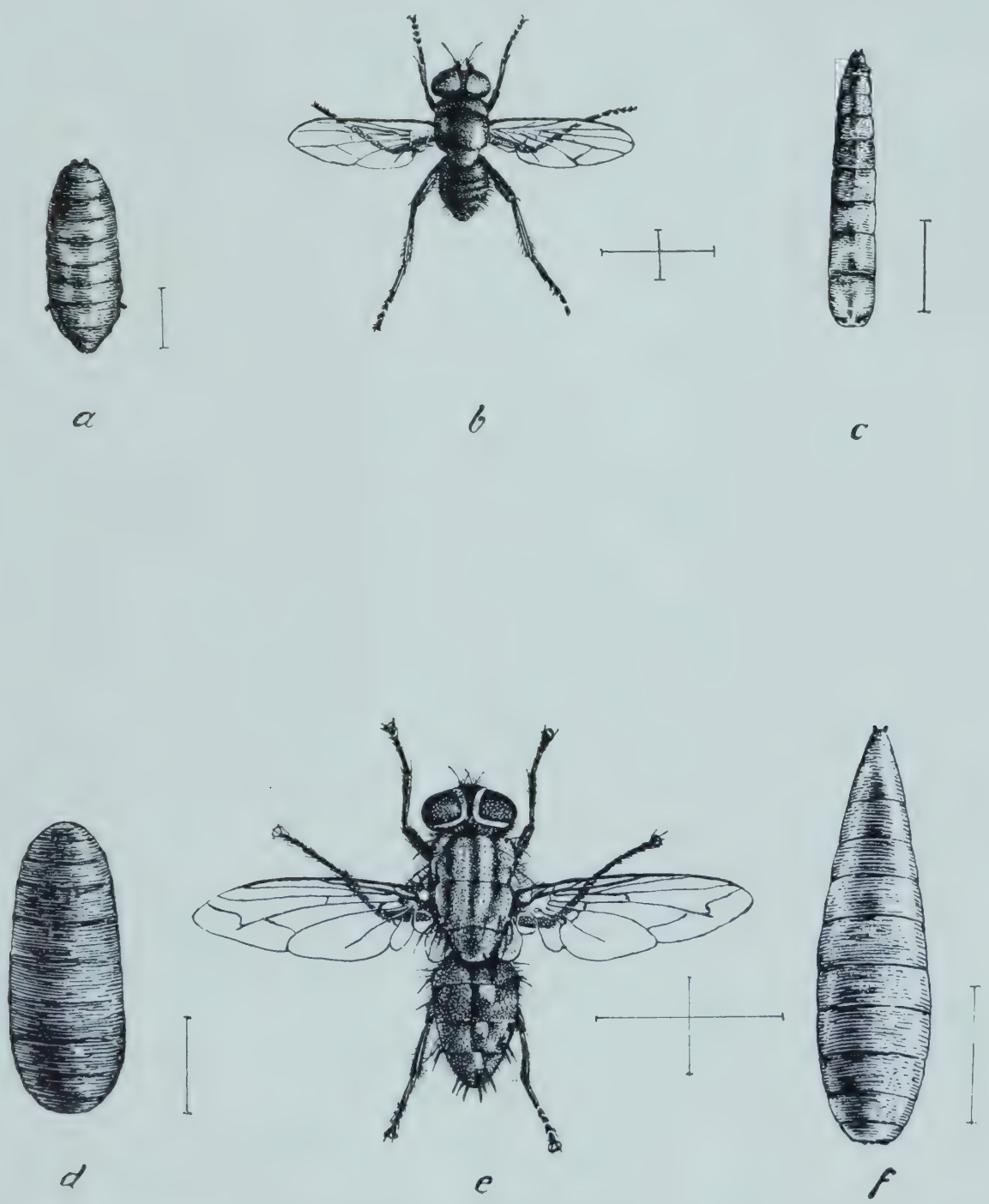
In several instances, where locust hoppers were being destroyed by the pit method, this species was noted as fairly prevalent and several times was seen ovipositing. The fly alighted on the small hopper and, straddling its back, despite the struggles of the hopper, succeeded in depositing an egg on the upper side of the second segment of the abdomen.

The full-grown larva of this fly (Plate IV) is nearly 2 centimeters long and grayish in color. Specimens which emerged from locusts spent sixteen days in the pupal stage. The most striking feature of these flies is the eyes which are large and reddish; the wings are clear with dark veins, while the body, especially the abdomen, is of a mottled light silvery color and is covered with black hairs.

The number of parasitized individuals never exceeded 6 per cent in our observations.

Unfortunately, individuals of this family are frequently attacked by the predaceous asilids which seem to prefer them to the hoppers.

Another species was a small fly of a brilliant metallic black color covered with numerous black hairs. This is apparently a tachinid and is the most abundant of the locust flies yet noted. The first specimens were bred from locusts taken in Nueva Ecija Province. Large numbers of them have been reared from winged locusts and an examination of 500 adult locusts showed that 17 per cent of them contained the maggots. As far as numbers go, it greatly exceeds those of other species reared, though fur-



Dipterous parasites of locusts: (*a*) Pupa of smaller locust fly; (*b*) adult; (*c*) larva; (*d*) pupa of large locust fly; (*e*) adult; (*f*) larva.



Nematode locust parasites: (*a*) Adult *Mermis* spp.; (*b*) adult *Gordius* spp.; (*c*) abdomen of locust showing nematode parasites.

ther investigation will be necessary to establish the economic importance of the species.

A single individual of a larger species of apparently the same family was reared. It closely resembles the preceding but is larger and lacks the bright metallic luster.

Hair worms.—Nematodes, or hair worms, as they are commonly called, infest many forms of insect life where they are found coiled up in the body cavity (Plate V).

Two species representing the two genera, *Gordius* and *Mermis*, have been taken from the Philippine locusts.

These parasites differ in habits, the former breeding in water while the latter is terrestrial.

While the life history of the Philippine forms is not definitely known, it is presumably the same as in other countries, the eggs being deposited in water, and the young, which are microscopic, crawling up on vegetation and reaching the host through the mouth with food; it undergoes its transformation in the body cavity of the locust and finally emerges through the anal segment.

The life cycle of *Mermis* is passed in much the same manner save that the eggs are laid in the ground instead of water. Individuals of *Gordius* are much larger than those of *Mermis*, the former being often 25 to 30 centimeters in length while the latter are shorter and more fragile.

It has been reported that whole swarms of locusts have been destroyed by these parasites in Negros, though reliable evidence confirming this information is lacking.

Our examinations of locusts infested with this class of parasites showed the highest percentage of parasitized individuals to be 7 per cent. In some cases as high as six parasites have been found in one locust.

Examination of gravid females often revealed parasitism by this species. The host seemed to suffer no great inconvenience from the presence of the parasite and every indication pointed to the fact that the locust would complete the function of oviposition in the normal manner.

It seems to be the consensus of opinion of the entomologists of other countries who have studied these parasites that as far as can be learned they are of little economic importance as locust destroyers.

Mites.—Mites seem to be present wherever locusts are found and are quite common in the Philippines.

While the life history and habits of our Philippine locust mites, *Trombidium*, has not been thoroughly studied, yet, accord-

ing to American authorities, they are among the most interesting of locust parasites.

The young mites which are six-legged are bright red in color. They climb up on the grass stems and crawl on the locust finally attaching themselves to the wings or some other protected part. Here they remain attached and suck up nourishment until the body swells, and after becoming full fed they drop off, undergo their metamorphosis and emerge as perfect eight-legged mites. During the adult stage they feed upon locust eggs until the completion of the life cycle.

These red locust mites are not uncommon on our Philippine plague locust. As far as is now known they are no great inconvenience to their hosts. Future investigation may add greatly to our knowledge of their economic importance.

In summing up the various parasites which affect the Philippine locust we find that, though varied, the percentage of parasitized individuals is small.

When considering that to completely control any pest it is necessary that the percentage killed by parasites, etc., must be *over 95 per cent* it is seen that the possibility of controlling locusts through this agency is very remote.

DISEASES.

It sometimes happens that with the right meteorological conditions large numbers of plant pests are destroyed through the agency of fungus of bacterial diseases.

At times they propagate and destroy locusts in their various stages, but they are dependant upon climatic conditions which can not be controlled by man.

Along these lines two organisms have come to notice: *Empusa grylli,* a fungus, and *Coccobacillus acridiorum,* a bacillus.

The former has been noted in the Islands, probably being indigenous, and doubtless destroys many locusts. The dead locusts hanging to blades of grass have been seen by the author in several provinces, the habit of infected locusts of seeking the light being characteristic of this disease. Prof. Lawrence Bruner of the University of Nebraska states that he noticed it in Laguna Province during the month of October, 1913. Unfortunately, it is impossible to cultivate this fungi with much success artificially and communicate it to locust swarms; while it can be handled to a limited extent in the laboratory where all conditions can be controlled, out of doors it has thus far failed to bring about the desired results.

A few years ago a new cocobacillus *Coccobacillus acridiorum* was discovered by D'Herelle in Mexico which was said to be fatal to locusts and harmless to other forms of animal life and for which a very bright future was predicted; reports published in various South American agricultural journals commented favorably on the results obtained.

Cultures of the disease were obtained from Argentina and under the direction of Doctor Barber, of the Bureau of Science, were brought to their maximum virulency in the laboratory, after which a through test was made under actual field condition on a swarm of half-grown locusts. Every possible precaution was taken and climatic conditions were ideal, the weather being warm and humid. Despite the high degree of virulency obtained under laboratory conditions, the results were practically nil. A few hoppers were found dead, but there was no evidence of the contagion spreading as was hoped.

An interesting article by Lounsbury in the South African Agricultural Journal for April, 1913, describes experiments with this disease on a nonmigratory locust which was very destructive in the Daspoort Gardens near Pretoria; the results obtained were virtually the same as those obtained in the Philippines. The following is quoted from this article:

> It appears to me in the light of the experience gained and from the information given by the Pasteur Institute that the disease at best can be used only as a supplementary measure in dealing with an invasion of locusts under the conditions which prevail in South Africa.

From information available it would seem that the possibility of employing parasites or diseases artificially in the destruction of locusts *is small* since they require conditions which are beyond our control.

During normal years locusts are held in check by the above-mentioned natural agencies. During abnormal seasons, when any of these factors are temporarily absent, we must rely upon our own efforts to control them.

ADVENTITIOUS GERMINATION IN DIOSCOREACEÆ.

By P. J. WESTER, *Horticulturist in Charge of the Lamao Experiment Station.*

It is a commonly accepted fact that when a plant is propagated vegetatively—that is, by means of the division of any part of the orginal plants, by tuber, root or stem cuttings, budding, etc.—in order to be capable of growing into plants the severed parts must have at least one "eye" or bud from which to form leaves and stems. A potato, for instance, to use a familiar case as an illustration, cannot germinate and grow into a plant if the "eyes" are removed; likewise in the case of certain exogenous plants, like the avocado, a bud may successfully "take" and make a perfect union with the stock, but if the leaf bud itself together with all leaf scales have been broken off or dropped the bud can never send forth any plant tissue; to use a horticultural term, it is "blind."

However, a few plants are exempt from this rule and have the peculiar and hitherto inexplicable power of spontaneously developing germinative tissue from which leaves and stems grow. Thus the leaves of the sansevierias and begonias may be cut into pieces, which are inserted in the soil like cuttings.

The ube (*Dioscorea alata* L.) is quite an important root crop in many districts of the Philippines. The proximal end of the tubers are saved for "seed" by the people as they are eaten, and planted during March and April, and it is commonly believed that the rest of the tuber is incapable of making any growth. However, the writer made observations to the contrary with the same species in Florida several years ago, and in order to determine if this peculiarity of *D. alata* extended to other species, the distal end of tubers of the following species were cut off in March and kept under observation at the Lamao experiment station: *Dioscorea alata* L., D. *aculeata* var. *tiliæfolia* Prain and Burkill, *D. triphylla* L., *D. pentaphylla L.*, and *Smilax sandwicensis*. In due time every one of these tubers germinated and developed into healthy vigorous plants after being set out in the field (Plate VI).



Distal ends of tubers of the *Dioscoreaceæ* showing germination: (*a*) *D. pentaphylla* L.; (*b*) and (*c*) *D. aculeata* var. *tiliaefolia* Prain and Burkhill; (*d*) and (*e*) *D. alata* L.; (*f*) *Smilax sandwicensis*.

While interesting to the student in morphology, the above fact is of great practical value to the grower of the above-mentioned plants. Thus a good-sized tuber of the ube may be cut into 6 or more parts for "seed," according to size. In those parts of the Islands where the rainy season coincides with or occurs shortly after the time of planting the tubers, these should be kept in a dry place in the shade until they have germinated and then planted, for otherwise they are apt to decay before germination takes place. This does not, of course, apply to the proximal end of the tuber which is well provided with buds that start promptly.

In this connection it may be of interest to know that if a tender seedling of *Annona cherimolia* Mill., *Rollinia orthopetala* A. DC., or *Uvaria rufa* Bl., is broken off below the cotyledons, germinative tissue will develop from the remaining budless stump if the plant is in good condition. This fact probably holds true in many other plants belonging to the same genera.

PERFORMANCE AND THE SCORE CARD.

By H. O. JACOBSON, *Agricultural Inspector.*

With the inauguration of the corn shows came the score card in a new application. The score card had become a familiar feature of live-stock exhibitions, but its use in grain judging was a decided innovation.

The writer recalls the introduction of the maize score card into the curriculum of the agronomy studies and it caused a great deal of speculation among the students at that time. To us it was a foregone conclusion that maize was maize and the biggest was unquestionably the best *per se*. Following the maize score card came cards for barley, wheat, oats, and rye.

The use of the score card is an invaluable aid to the student in training his faculty for observation, but he frequently fails to realize its relative value, and it may deprive the observer of a proper perspective of the problem in hand.

It is safe to say that in the last decade too much emphasis has been placed upon seed selection by the score card, both by the agricultural press and instructors in the elementary agricultural schools. Sufficient stress has not been laid upon the fundamental principles governing seed improvement, resulting in considerable confusion among farmers and prospective maize breeders.

The values of the score card are arbitrary and are established on premises based somewhat more on theory than on facts supported by proof.

It is supposed to represent a model of perfection and is intended to serve as a standard by which results are gauged rather than a guide for the direction of the breeder.

All the problems of the maize breeder have a direct relation to their economic values. Maize has no other than a utilitarian value. The relative value of any variety or strain of maize is always in direct proportion to its capacity for performance or yield of shelled maize.

Yield or performance is therefore the object sought which must ever be kept in view and all other features must be subsidiary to it.

If the score card is to serve as a guide for seed selection, then each point upon which an ear is judged should bear some association or be a correlative factor to yield.

Unfortunately, this is the weakness of the maize score card in common with all other mechanical means for measuring invisible characteristics.

Pearl says, in Bulletin 183, Maine Experiment Station:

> Two years' ear-to-the-row tests furnish no evidence that there is any close association or correlation between the size or conformation of the seed ear and the *yield* of maize obtained from it upon planting. The large, well tipped, and beautifully shaped ear is as likely as not to prove a poor yielder when planted. This result means that the external, visible characteristics of the ear are a very unreliable indication of its probable worth for seed purposes * * *.

The score card has but a limited scope and necessarily deals only with the visible characteristics of the ear. A prominent Indiana maize breeder paid ₱200 for the sweep-stakes ear at a big exhibition. When planted, this ear did not yield quite as much as the average secured in the field of common seed grown for feeding purposes.

Countless numbers of amateur maize breeders placing their sole reliance on the dictum of the score card have painstakingly selected their seed, only to be disappointed in yield. When field selection has been resorted to, more satisfactory results have been obtained, even though falling considerably short of results hoped for.

We will briefly consider two points on the score card as to their possible values as indices for performance.

SHAPE OF EAR.

A perfect ear, according to most score cards, should be cylindrical. Some few varieties are allowed to have a very slightly tapering shape. Calculated on a geometrical basis, a cylindrical ear should carry a larger net weight of kernels and logically this shape ought to be a reliable index for high production, because if like produces like, the progeny should be cylindrical and carry more grain than the progeny of a tapering ear. Experimentation is perhaps insufficient to definitely answer this question, but results so far secured suggest that this point has little value in indicating potential efficiency in production.

Williams, at the Ohio Experiment Station, in 18 tests found that the tapering seed ears yielded 0.87 bushel per acre more than the cylindrical ears.

Webber, at Cornell University, found no difference in yield in comparing the performance of the two shapes in seed ears.

TIPS OF EARS.

Williams also compared the performance of seed ears with bare tips with those having well-filled tips. A gain of only 1.07 bushels per acre, or slightly over 2 per cent, was found in favor of seed ears with well-filled tips.

Respecting this feature in seed ears it should be remembered that failure to cover the tip with kernels is frequently due to unfavorable climatic conditions which prevent fertilization of the embryo and is in itself not strictly a heritable characteristic.

Tests with reference to number of rows of kernels, percentage of shelled maize, and weight and length of ear do not indicate positively that any of these characters can be associated with yield with any degree of constancy.

But when the factor for performance has been established for the progeny of an ear or a number of ears, the score card may be brought into use in order to assemble the new lot of seed ears conforming to one standard in external characteristics. Let us be consistent in our judgment. When we discard an ear because of this defect or the other, let us do so on the grounds of unsightliness and not on the strength of the hypothetical argument that such and such an ear will probably not yield well.

The failure to recognize individuality in our grain plants has hindered progress in the direction of improvement in both quality and yield. It has been customary to regard plants as populations, thereby entirely overlooking the superior individuals, but this fallacy in thought and practice is now being corrected.

Promiscuous selection of seed maize has probably never resulted in increased yield except by accident. The early maize breeders of the United States, while they did not practice the methods in vogue at present, certainly did recognize the individuality of the maize plants and selected the seed afield in most instances. It naturally followed that where sufficient interest was aroused to select seed with care, environmental conditions were also improved.

It should be clearly recognized that judging seed maize by the score card is merely assembling to a given standard in

visible characteristics and that these visible characteristics do not necessarily bear any relation to productivity. Uniformity in external characteristics is desirable and valuable but is always subordinate to performance.

At present there is no other way of testing the performance of an ear of seed maize other than that of actually planting a portion of its kernels and making observations on its growth and production. The scales eventually tell the story.

An error which many a breeder has fallen into is that of being led away from the main object in view by unconsciously attaching too much importance to some minor characteristic. Such things are common enough among live-stock breeders.

In maize it has happened that in the effort to secure an abnormally large percentage of grain to cob, the yield has receded to a very nominal figure. Yet it is common knowledge among maize breeders that few highly productive varieties exceed 85 per cent of shelled grain. The writer has never found a highly productive mother ear that would shell out a high percentage of grain.

While the following has no direct reference to the score card, it concerns advice that is frequently unqualifiedly given as bearing a direct relation to yield—the theory regarding prolificacy of ears in maize. The argument, threadbare with discussion, that a stalk with two ears is more profitable than one having but a single ear is logical theoretically, but it has not yet been proved as a fact in practice. As a matter of record the notably prolific varieties have so far failed utterly to maintain a creditable position in point of yield with the single-eared varieties. The production of grain depends in a large measure on the environmental conditions, such as plant food, water, temperature, sunshine, etc. If these are not present sufficiently to produce one good ear per stalk it certainly is folly to try to produce two. Therefore it is inconsistent to select seed of a multi-eared variety unless the soil is unusually fertile.

A number of years ago the writer secured some seed of a multi-eared variety known as Iowa Gold Mine. This strain, producing from two to nine ears per stalk, was planted side by side with a standard single-eared variety on heavily fertilized soil. While it produced a large number of ears, the yield fell 33 per cent below that of the single-eared variety. On moderately fertile soil the yield was very poor indeed, since most of the ears were rudimentary and poorly developed.

The Minnesota Experiment Station, after a number of years'

work in attempting to place a multi-eared variety in the first rank in productivity, discontinued the experiment, declaring that prolificacy in ears as a varietal characteristic was of insufficient practical value to receive special consideration.

When selecting seed in the field, pick those ears which conform to your idea of excellence regardless of the number of ears the stalk carries, and when testing the productivity of seed ears select those which come off the high-yielding rows irrespective of the multi-ear theory. In the end you will have a more satisfactory result if you confine your attention to a single purpose.

AGRICULTURAL CONDITIONS IN THE SUBPROVINCE OF BONTOC.

By A. M. BURTON, *Agricultural Inspector.*

Bontoc, a subprovince of the Mountain Province, is located in the north-central part of Luzon. On account of the mountainous character of the subprovince there is not a great deal of arable land, but the Igorots utilize every foot which can be used for crop production. Their terraced and irrigated hillsides which are planted to rice are remarkable examples of engineering work and show that the Igorots possess a degree of engineering skill beyond what might be expected of a people in their stage of civilization.

Rice and camotes are the two crops most extensively grown in the subprovince and constitute the main diet of the Igorot. Neither rice nor camotes are exported.

Maize has been widely distributed over the subprovince by the Bureau of Agriculture and has thrived under Bontoc conditions. It is expected that maize will eventually become one of the more important crops of Bontoc.

Some tobacco of fairly good grade is raised in the northern part of the subprovince. This tobacco is all consumed locally.

Sugar cane is grown throughout the subprovince, but only in small quantities. It is all used locally in the manufacture of "basi," a native alcoholic drink.

Coffee is grown in small quantities, principally in Bontoc and Sagada townships. The coffee raised is of good quality, but is a rather uncertain crop on account of the danger from typhoons and disease. About 50,000 seedlings have been distributed from the Bontoc jail garden during the past year. These have all been planted in small individual plots around the homes of the people. Even though these trees may eventually succumb to the blight, observation of the older trees now growing indicates that the new trees should bear several crops, enough to pay a generous profit over the cost of planting, care, and harvesting, before succumbing. Plantings of Liberian coffee, which is more blight resistant than the native varieties, have been made in some of the townships in the lower altitudes.

Quite a variety of vegetables not indigenous to this country have been grown in the subprovince of Bontoc under the supervision of the Bureau of Agriculture and many of them, such as peas, beans, radishes, turnips, lettuce, cabbage, beets, onions, pechay, cucumbers, American sweet potatoes, tomatoes, eggplants, and peppers, have proved so satisfactory as to create quite a demand for their more extensive distribution in the future.

Papaya did exceedingly well in Bontoc and plantings of papaya are now being made in many sections of the subprovince.

There are no data available regarding the number of cattle raised in the subprovince as most of the animals are wild, not having been corralled, and have not been branded. Steps were taken last year in the matter of branding the larger animals which are now being branded and registered as rapidly as they can be caught. There are more carabao than cattle in the subprovince.

Quite a number of pigs are raised in Bontoc, each house owner having from one to three animals.

There are 282 kilometers of roads and trails in the subprovince of which 44 kilometers are cart trail, 157 kilometers horse trail with a maximum grade of 6 per cent, and 81 kilometers horse trail of high grade.

An improvement completed during the last fiscal year is an irrigation ditch 3 kilometers in length which irrigates approximately 16 hectares of rice land in the town of Bontoc. The first crop from this newly irrigated land was harvested in June, 1913.

Another important project which will probably be undertaken this year is the construction of a ditch which will irrigate approximately 20 hectares in the town of Tucucan.

There are several forests of pine in the subprovince. A saw and shingle mill is operated at Fidelizan in the township of Sagada.

Excellent pottery clay is found in the town of Samoki and quite a number of Igorots make jars of this clay which they sell throughout the subprovince.

A superior grade of brick clay and building stone is found in the town of Bontoc and both have been utilized in the construction of the government buildings there.

EXPLORATION TRIP INTO THE INTERIOR OF CATANDUANES ISLAND, ALBAY, P. I.

By E. H. KOERT, *Superintendent of Breeding Work on Catanduanes Island.*

On July 31, 1913, a party, organized by the writer, left Virac to make an exploration of the interior of the Island of Catanduanes with respect to possible future agricultural development. The party consisted of two Filipino woodsmen, seven bearers, Mr. P. N. Sturtevant (the local head teacher), and the undersigned.

Leaving Virac about 9.30 a. m., the party proceeded to the Bicol farm, jointly maintained by the subprovince of Catanduanes and the Bureau of Agriculture; thence along the valley of the Pajo River to the barrio of Buyo where a short stop was made for lunch; in the afternoon the channel of the Pajo River was followed to the "visita"[1] of Dugui (mud), the last outpost of civilization, arriving there about 5 p. m. In both Buyo and Dugui a considerable number of people showed traces of a blood different from that of the Filipino, bearing out a statement made by the writer on another occasion of the presence of a foreign strain of blood among the inhabitants of Catanduanes Island.

Dugui is the last place inhabited; further in the interior not even a single house is to be found. It is a typical Catanduanes pioneer settlement. On the land around their houses the people have plats of camotes, vegetables, maize, and a little sugar cane; on the near-by hillsides their abacá plantings are seen, with a few coconut trees here and there. During the time it takes for their abacá and coconuts to become productive they supply their "store necessities" with the proceeds received for rattan and other forest products gathered.

Shortly before arriving at Dugui a ridge is noted, running at right angles to the Pajo River. Prior to the time that the river forced a channel through this ridge, the three valleys, formed by the three rivers which unite in the Pajo River, no doubt were the bottom lands near Dugui; the name Dugui (mud) doubtless originated from this. The narrow channel through the ridge has probably been closed at times by boulders and other

[1] An outlying group of houses.

obstructions, and when the dam was finally broken by the force of the water, the accumulation of gravel was evidently carried out upon the lowlands of Virac, thus forming the various strata.

Near Dugui a large, well-formed tree was noted, loaded down with a large plum-like fruit, locally known as "lubas." Upon inquiry it was found that the Filipinos use the leaves and fruit of this tree extensively in cooking. The latter was found to be quite acid. Later on during the trip another tree was found with the fruit much sweeter. On the return to Virac a quantity of this fruit was secured, and plum butter of a very fine flavor made, greatly relished by a considerable number of people who had occasion to try it.

Early in the morning of August 1 the party left Dugui, and following the channel of a small creek to its headwaters, continued up the ridge from which it rises, this ridge being found to be an outrunner of Mount Bulan, our objective point. About 3 p. m. an elevation of some 600 meters was reached, and camp was made along the headwaters of one of the branches of the Pajo River.

During the day no discoveries worth mentioning were made, the route having been principally along a stony ridge, following the trails of the wild pig which abounds in that locality.

The night of August 1 was spent somewhat uncomfortably, as the hastily constructed shelter of the afternoon before was not sufficient to keep out the heavy downpour of rain experienced during the night.

The rainfall just below the top of Mount Bulan appears to be exceptionally heavy. Thunder was heard practically at all times.

On the 2d of August the party continued. After a sharp climb for about 150 meters a gently sloping mountain side was reached. The timber here was of a dwarf type, with white oak abounding, intermingled with karagomoy and various species of the rattan family. In this locality wild chickens and deer were seen in great numbers. Several of the latter were secured during the two days on the mountain.

Fifteen minutes later we reached the top of Mount Bulan. Without doubt the members of our party were the first Caucasians to reach the interior of Catanduanes, but it must be admitted that signs were found of others having been there before, and no doubt a settlement of *remontados*[1] will be found in the val-

[1] Mountain people, usually criminals or those unwilling to live in civilized communities.

ley to the north of Mount Bulan. A fine view of the greater part of the Island of Catanduanes was obtainable from here. (Fig. 1.)

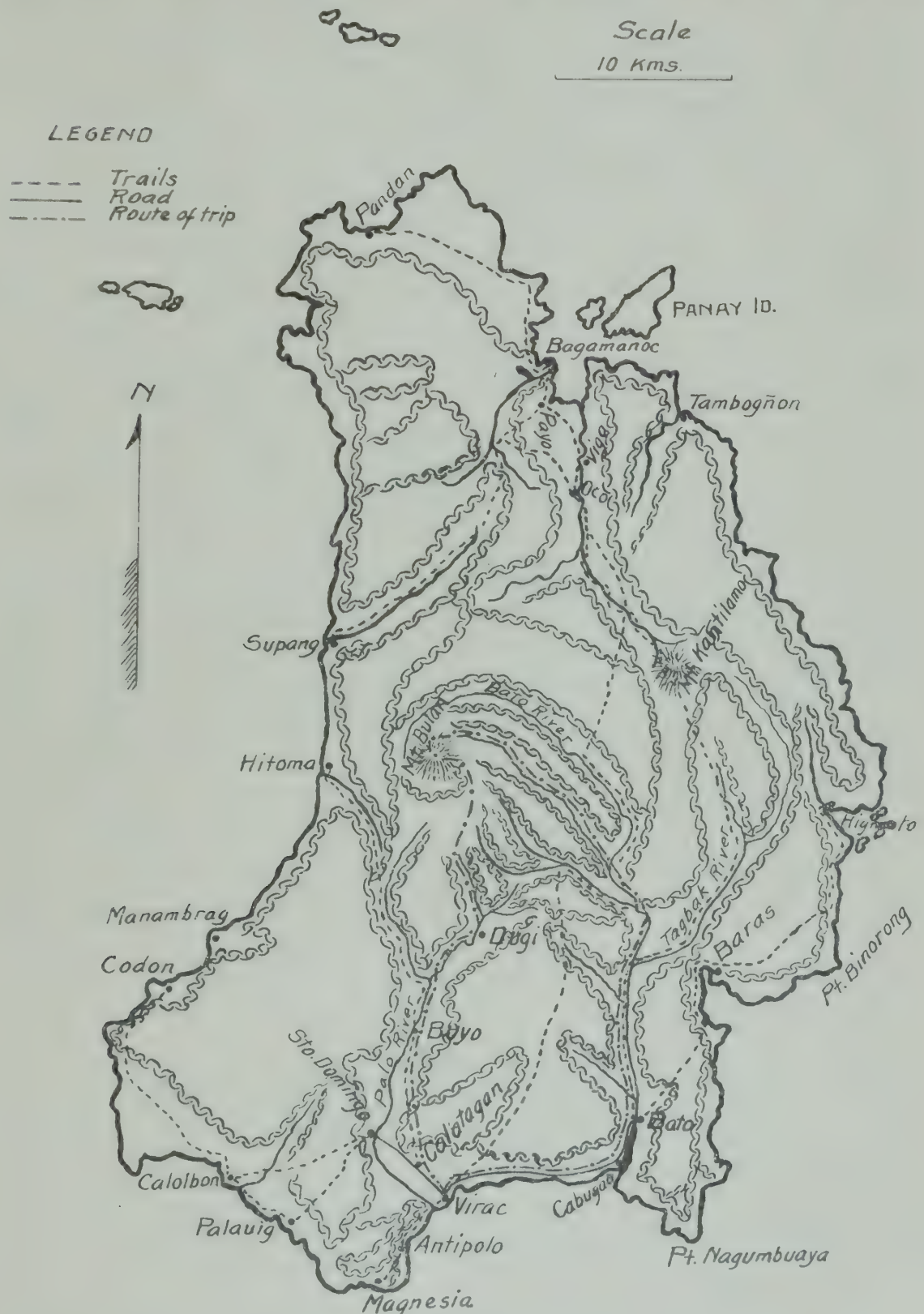


Fig. 1.

The top of the mountain is a plateau overgrown with what is known as gajo, a reedy grass. The formation appears to be mostly iron. This was verified Monday morning by making a

closer examination along the bed of the creek where camp was made. The intention had been to descend the mountain on the north side, but this appeared to be impossible, the mountain making a sheer drop. Accordingly, early Monday morning the party started to return to Virac, following the course of the brook where camp had been made.

While descending, a waterfall had to be avoided which a conservative estimate would place at not less than 120 meters in height. A good deal of difficulty was encountered upon reaching the north to south ridge of the island previously mentioned, and which appears to cross all rivers with a southern outlet more or less at right angles. The channel of the river which the party was following (the Caglatauan) at this place was very narrow, and could not be forded; an attempt resulted in the man trying it having to swim in the ice-cold water. The rest of the party accomplished the passage by clinging to roots and trees, and thus eventually reached the river at the farther side of the cross ridge.

From the knowledge acquired by the writer in several trips into the interior of the conditions of the Himigman, Caglatauan (where the alligator abounds), and the Bato Rivers, it is safe to predict that if these rivers should happen to be dammed during a baguio, the sudden breaking of this dam would wipe out the entire valley of the Bato River. The means to prevent this are simple and comparatively inexpensive; a few charges of dynamite, judiciously placed, would remove this danger.

On the afternoon of August 4 camp was made early on the Caglatauan, some 180 meters above its junction with the Bato River.

The balance of the day was spent in the collection of plants and fruits; the following is a list of those secured:

A flat brown nut, locally known as "bulagun."
A fruit similar to the chestnut known as "barobu" or "malbuo."
A fruit the size of a hazlenut used as salad, and known as "llaiuan."
A large square fruit, very sweet, known as "birian."
A small oval fruit, both sweet and sour, known as "tublun."
A fruit similar to but smaller than the santol, known as "alauihau."
A plumlike fruit, some sour, some sweet, known as "lubas."
A small oblong berry, red in color and greatly liked by the monkeys, sometimes called "uayog."
An unnamed berry, similar to the above, but more cherrylike, yellow in color.
A small berry used by the people when buyo is not procurable.
An unknown brown tuber.

A considerable number of specimens were collected, but many of these have failed to grow; however, it is likely that most of these can be secured near by. Conditions at the Bicol farm will be more favorable in the future to assure the continued growth of the forest products that may be collected.

On August 5 the return to Virac was accomplished. At the junction of the Caglatauan and Bato Rivers a number of rapids have to be forded which are quite dangerous, and a deep stretch of water is encountered. About an hour's travel below this place is the junction of the Bato River with the Himigminan, meaning wetstone, from a peculiar kind of rock found in this place. Another hour's travel brought the party to the junction of the Bato River with the Tagbac River and the Virac to Viga trail. From here on it is some 24 kilometers into Virac.

From indications it would appear that a trip up the Bato River is necessary for the following reasons: First to locate the habitations of the *remontados* which probably are at or near its source; second, to make a collection of the plants that are to be found in the large valley formed by it and also to visit the large patches of wild hemp that are known to be along this river. The object of the trip already made was in part to secure this collection, although it could not be accomplished on account of not being able to descend Mount Bulan on the north.

CURRENT NOTES—NOVEMBER.

NOTES BY O. W. BARRETT, Chief, Division of Horticulture.

DUTCH EAST INDIES COPRA.

The present output of copra in the Dutch East Indies is some 150,000 against 115,000 tons for the Philippines. Java and Madura are now exporting about 100,000 tons of medium-grade copra per annum, while Celebes produces in the neighborhood of 40,000. The normal Philippine output is about 170,000 tons. Sumatra thus far has produced very little copra, but several European companies are planting up large areas and according to the Daily Consular and Trade Reports fully 4,000 hectares are in young coconuts.

A German company has taken up a large block of land on the west coast of Celebes and gradually this crop is receiving more attention and extending itself throughout the eastern section of Netherlands Indies. Wherefore we must conclude that unless Filipino planters bend every effort to the extension of the industry in the Philippines there is no question but that in a few years Dutch East Indies will far exceed the Philippines in copra production.

A NEW COCONUT HUSKER.

We learn from the Daily Consular and Trade Reports that considerable interest has lately been aroused in a German machine for husking coconuts. This machine, which costs about ₱125—

consists of two sets of cone anvil cutters, arranged one above the other, each consisting of three radially placed blades, of which the lower cutter may be adjusted vertically by a lever and can be adjusted to prevent it from turning, whereas the upper one is worked by a handwheel. The coconut is placed point uppermost between the blades, and then the lower cutter is pressed upwards by setting the foot on the counterweights. This causes the blades, which are exactly opposite to one another, to cut into the layer of fiber as far as the hard shell. By causing the upper cutter to revolve by the handwheel, the entire layer of fiber is divided into three long longitudinal segments which can then be easily removed by hand. This process

does not present the slightest difficulty with fresh coconuts, so that a skilled workman can remove the fiber from as many as 100 nuts an hour.

Conservatively speaking, however, we can hardly feel greatly encouraged over the prophesied success of this machine for the simple reason that an experienced Filipino husker will finish 2 to 4 nuts per minute, which is to say at least 125 nuts per hour; obviously, therefore, this machine would have to do three or four times as much work in a given time as the average laborer would do in order to win favor in this country. (Possibly the above-quoted notice should read "1,000 nuts per hour" instead of "100"—the writer having seen in Zambesia, East Africa, a machine, operated by four men, that was capable of partially husking about 1,000 nuts per hour *when not laid up for repairs.*)

A NEW BOOK ON THE BANANA.

We learn from the Agricultural News of Barbados that a book on banana culture is being published by Wm. Fawcett, esq., ex-director of public gardens and plantations at Kingston, Jamaica. The banana crop is steadily increasing in importance throughout tropical America and this book written in the very center of the trade region of this crop should be highly authoritative. It should be remembered that there are now 130 specially constructed banana steamers handling the 60 million or more bunches of the so-called "Jamaica" banana per annum. Jamaica alone produces 17 million bunches per year and the United States consumes over 40 million bunches.

A review of all the species of bananas, wild and cultivated, together with interesting notes of botanical and horticultural interest will be included, it is understood, in this forthcoming publication. It will be interesting to note just what opinions Mr. Fawcett will express concerning Schumann's 42 species as given in Engler's monograph. By the way, a French tropical-agriculture publication has recently announced that there are 196 species and varieties of banana known at present. (The Bureau of Agriculture collection contains well over 300 numbers and it is probable that fully 100, if not 200 *more* varieties can be obtained, if all goes well, within one year.

The tropical planters in both hemispheres will warmly welcome any practical work on this exceedingly important, but thus far unpopular crop in the Philippines; for we all are beginning to realize the prominent part the banana is going to play in tropical agriculture in the future.

ARGENTINE EXPERIMENTAL FARMS.

Seven new experimental farms have just been established in the Province of San Juan, Argentina.

Both the Argentine Republic and Brazil are rapidly extending their lines of action in the way of demonstration farms and experiment stations. Several experts from America and Europe have recently been appointed to high positions as advisors or instructors in this line of work. The northern part of Argentina, where subtropical conditions exist, is developing rapidly and the entire valley of the Rio de la Plata is becoming transformed into a vast domain of modern agricultural development. Great as is this valley, however, it hardly compares with that of the Amazon which is considerably the largest in the world—covering an area of some 7 million square kilometers (about 2,500,000 square miles). The total area of the Philippine Islands is under 300,000 square kilometers (about 114,500 square miles), or only about one-twenty-third the area of the Amazonas watershed.

A NEW COLLEGE OF AGRICULTURE.

The Republic of Guatemala has established a college of agriculture to satisfy the rapidly increasing demand for technical education in the agricultural sciences. President Estrada Cabrera founded the institute on January 13, 1913, at Guatemala City. There is no doubt that, as the Bulletin of the Pan-American Union prophesies, "from henceforth the influence of the school of agriculture will be a prominent feature in the development of the immense and varied agricultural resources of the country."

A RIVAL TO THE PANAMA EXPOSITION.

We learn from the Bulletin of the Pan-American Union for April, 1913, that the Republic of Panama has introduced a bill into the Congress of Panama to authorize the executive bureau to invest ₱500,000 "for the celebration in 1915 of a national exposition." A smaller sum has actually been put at the "disposal of the President of the Republic to celebrate the discovery of the Pacific by Balboa in 1513, but President Porres recommended that this be increased to ₱500,000 so that the event could be celebrated on a larger scale and in a more fitting manner." If this sum of money is expended in old Panama City in celebrating the discovery of the Pacific it may in some ways cause more or less confusion in the minds of European and oriental countries, occurring as it would simultaneously with the Panama Exposi-

tion at San Francisco. It is understood that the Panama Government purposes to invite participation in the exposition by all the governments of the Western Hemisphere, besides a number of the European countries.

QUININE FACTORY.

A new factory at Bandoeng, Java, is very actively engaged in filling orders "direct to dealers" for drug preparations of quinine freshly made right in the heart of the greatest quinine-producing district of the world. Shipments of the crude bark to the United States continue, of course, and for the year 1912 amount to nearly 10,000 tons. In this connection it is of interest to remember that the Dutch chemists, by the application of modern scientific methods of plant breeding, have increased the quinine content of certain varieties of cinchona under cultivation in Java from 7 to 15 per cent.

CHICLE OUTPUT.

It seems hardly credible that the present consumption of chicle in the United States amounts to *15 tons per day*, practically all of this being made into chewing gum which is placed on the market under a variety of names and in a variety of flavors.

A new method has been suggested for the extraction of this gum which may somewhat relieve the heavy tax on the rather limited (Mexican) forest supply; the young fruits are known to be filled with this gutta-percha-like latex and very probably some method may be found by which the half-grown fruits can be removed from the trees, boiled, and made to yield up their chicle content, thus leaving the tree unscarred by the deep tapping wounds which have heretofore been a serious feature of the case.

COPRA IMPORTS OF THE UNITED STATES.

There seems no doubt that copra imports into United States are increasing by leaps and bounds; for instance, in 1910 only about 13,000 tons were brought in while in 1911 there were over 23,000 tons handled, and in 1912 considerably over 31,000 tons; these figures do not include desiccated (or "shredded") coconut.

FRUIT-FLY DANGERS.

Probably all tropical countries are more or less infested with various species of fruit flies, Hawaii and Mexico being perhaps the most severely affected. A fixed quarantine against Mexican oranges is now being maintained on the Texas-Mexico frontier.

In 1899 and 1900 the writer made the first official inspection of the citrus districts of Mexico, finding the fruit even in the best orange districts very severely infested, in some cases 75 per cent of the fruit being attacked by the maggots of these fruit flies. In November, 1899, maggots were detected in Mexican oranges imported into San Francisco. Only recently, however, has the United States Government taken a firm stand toward preventing the introduction of this pest into the fruit-growing districts of the Southwest.

Doctor Sylvestri of the Italian Government has recently returned via America and Hawaii from a trip to West Africa after parasites of fruit flies. While a considerable number of various parasites of several species of fruit-infesting insects were discovered, it remains to be seen whether they will really check the infestation to any great extent. Various methods for trapping or controlling the adult fruit flies have been suggested; it appears quite feasible to trap a large percentage of the males in an infested grove by means of bright basins filled with kerosene. Strangely enough the famous Mally fruit-fly remedy of South Africa, which consists in spraying poisoned mixtures upon the leaves of infested trees, does not seem to have become popular, though it is probable that if properly applied this remedy would considerably reduce the pest, at least in districts where the natural host plants of the fly were absent.

The Philippines have a few species of fruit fly, but fortunately none of them seem to be doing any considerable damage thus far, and at least one of them is parasitized.

ARGENTINE COMMERCE.

Argentina has produced during the fiscal year of 1912 some 342,000 tons of beef besides about 70,000 tons of fresh mutton. The value of the beef and mutton exported amounted to about 80 million pesos. The total value of all animal products amounted in 1912 to not less than 376 million pesos, while that of the crop exports was over 560 million pesos in value, according to the Bulletin of the Pan-American Union.

VENEZUELAN BEEF.

On every hand there is evidence of agricultural progress from one end to the other of the great South American continent. For instance, in Venezuela there has just been established a gigantic stock-raising concern near La Guayra with a capital of ₱386,000; in the far interior at Barrancas on the Orinoco

River an establishment, equipped to handle some 25,000 head of cattle per year, has just been installed; this plant will make extracts, gelatine, and fertilizer, as well as salted meat.

Considering the excellent means of transportation that this plant will have and the exceedingly low price of cattle in that part of the world, success should be assured. A few years ago cattle were so cheap in the hinterland of Venezuela that they were shot merely for the sake of the skins, the meat being considered hardly worth saving.

ANOTHER TROPICAL AGRICULTURE JOURNAL.

The Fiji Planters' Journal bids fair to become one of the most interesting and valuable of the recent tropical agriculture publications; we are just in receipt of the second number of this journal which contains some 74 pages of interesting data on the various tropical crops of the Fiji Archipelago, together with market reports and crop statistics.

In an interesting article on coconut growing by H. H. Thiele, esq., we regret to note that bud rot occurs at present in Fiji.

It appears that Fiji is troubled with a peculiar coconut insect pest not known in other countries—a comparatively large Phasmid, or stick insect, which feeds upon the leaflets; there are two species of this pest, the larger one (*Phibalocera pythonius*) reaches a length of 20 or more centimeters and is wingless, while the other, of about half that size, is said to be a common and sometimes very severe pest in the "South Sea Islands." On the other hand, Fiji seems to be tolerably free from the terrible "uang," or rhinoceros beetle, of the Philippines.

A CUBAN COMMERCIAL EXPOSITION.

It is reported that the chamber of commerce of Santiago de Cuba intends to hold a national exposition to celebrate the official opening of the Panama Canal in the beginning of the year 1915.

NOTES BY P. J. WESTER, Horticulturist.

FARM PREMIERING IN SWEDEN.

The high standard of agriculture and husbandry and everything pertaining thereto in the two Scandinavian countries of Sweden and Denmark is a matter of common knowledge among those well informed, but owing to the linguistic isolation of these countries from the rest of the world many of the methods employed in the stimulation of this development are but little known.

The premiering of cattle, horses, and other domestic animals, and the competitive exhibitions of the manifold forms of handicraft as a stimulation to better productions are of commonplace occurrence in most countries, but it is not generally known that the Swedes have for several years extended this to the farms.

In those parts of the country where farm premiering is in practice the farmers who wish to compete forward their applications to the provincial authorities in charge of this work. An inspection jury is then selected which inspects the farms entered in the competition and awards the prizes.

In many parts of Sweden as in Germany it is a common practice to plant fruit trees along the roads which thus produce a valuable income and at the same time serve as shade trees.

We believe the Philippines would be a gainer by the emulation of the two practices above mentioned.

THE PROSPECTS OF THE AVOCADO IN THE PHILIPPINES.

It is a rather remarkable fact that the introduction by the Spaniards into the Philippines of the avocado, one of the most esteemed fruits of the American Tropics, was a failure, and it has remained for us to reintroduce this valuable fruit. As a matter of fact, avocado introduction seems to have been one of the first things that claimed the attention of the Bureau during its early days, and while those first introduced have been coming into bearing several importations of seed as well as bud wood have been made during the last two years culminating in the recent importation of 3,000 seeds from Hawaii.

Several of the avocados planted at the Lamao experiment station several years ago by the then horticulturist of the Bureau, Mr. W. S. Lyon, fruited this year. The flowers "set" very satisfactorily, but when the fruit was about or a trifle more than half-grown (in the height of the rainy season) practically all the fruit split and dropped. This was unquestionably due to the excessive sap pressure, while the fact that two seedlings were not so affected shows that individuality plays a more or less important part also.

The trouble mentioned has been noted for some years in Manila also, where the seasons are similar to those at Lamao, and it would seem that the prospective commercial avocado districts of the future should be located where the dry season coincides with the flowering and the ripening periods of the avocado, which in the Philippines seem to extend from February to the

beginning of September. It is very probable that the highlands of Mindanao, with their evenly distributed rainfall and cool atmosphere, would produce a very superior avocado. In those sections where the rain falls principally from February to September avocado culture cannot be advised on any considerable scale and only those kinds should be planted there that have conclusively proved themselves immune to excessive precipitation during those months.

A "NEW" WEED KILLER.

This is, of course, comparatively speaking. It is safe to say that the "weed killer" referred to is unknown to Philippine agriculturists, though it seems to be a standard remedy now in some parts of the world. We refer, of course, to the destruction of weeds by chemicals, arsenite of soda in particular.

Fungicides and insecticides were the first sprays devised to combat plant pests and it was in the course of their application that the different effects of various chemicals upon different species of plants were first noted and followed by experimental spraying of plants with the object of utilizing the spray mixture as a, shall we say, "weedicide."

Among other chemicals, carbolic acid, benzine, kerosene, salt, sulphuric acid, copper sulphate, and arsenate of soda have been experimented with, but it seems that arsenite of soda has carried off the honors as a weed destroyer.

According to Wilcox in Press Bulletin No. 30, Hawaii Agricultural Experiment Station, arsenite of soda is used to a considerable extent in Hawaii as a weed destroyer.

We quote the following from the bulletin referred to:

Arsenite of soda.—This chemical is usually prepared by boiling together common white arsenic and washing soda or sal soda. Theoretically, these chemicals combine in such a proportion that if about 1½ pounds of soda be used for each pound of arsenic, the proper combination will take place to render all of the arsenic soluble by the formation of arsenic of soda. In practice a considerably larger proportion of soda has been used, up to 4 pounds per pound of white arsenic. In preparing arsenite of soda we have had good results from boiling a mixture of 1 pound of white arsenic and 2 pounds sal soda per gallon of water for from fifteen to twenty minutes. The exact length of time to continue the boiling cannot be stated beforehand with any certainty but the boiling should be continued until the solution becomes clear. The clearing of the solution indicates that the proper chemical combination has taken place. * * * The stock solution obtained by boiling together white arsenic and sal soda is to be diluted before spraying with 15 to 24 parts of water, depending on the hardiness of the weeds to be destroyed.

In Australia, where, according to Wilcox, arsenite of soda has been widely used in weed destruction, the arsenite of soda already prepared is bought in the market and dissolved in water. It has there been used (in the destruction of the prickly pear) at the rate of 1 pound of arsenite of soda to from 5 to 9 gallons of water. For shrubby weeds a somewhat more concentrated solution has been used. According to Wilcox, arsenate of soda may be substituted for arsenite of soda.

In Hawaii some 500 acres have recently been treated with arsenite of soda by various rubber companies operating in that Archipelago and with very satisfactory results. The total cost per application, including material and labor, is ₱2.50 to ₱4.50 per acre. This destroys all except the most hardy weeds, which require one and sometimes two applications before they are entirely killed. About 100 gallons of the mixture is required to spray 1 acre.

As in the spraying of fungicides or insecticides, the mixture should be applied to the plant in a fine mist and not in such quantities that the solution runs down the plant into the ground, for, if excessive applications are repeatedly made, the accumulated arsenic in the land is poisonous to the cultivated plants. However, there is less danger from this source in the Tropics where the rainfall is abundant than in those countries where the annual precipitation is small.

NEW POSSIBILITIES IN DATE CULTURE.

It is well known that the date thrives in dry as well as humid climates within the Tropics and subtropics, though many people still labor under the delusion that the date can succeed under desert conditions only, owing to the fact that because of the large sugar content the ripening fruit ferments at low altitudes. This is due to the excessive humidity in those regions and date culture on a commercial scale has therefore been confined to arid regions where the fruit "cures" without difficulty.

It is now nearly fifteen years since the United States Department of Agriculture first undertook to import date suckers from the date-growing regions of the Old World and this met with sufficient success to encourage the dispatch of a second expedition for the same purpose, and this was again followed by others in order to obtain more material as well as to study the culture of the plant with a view of making part of the southwest of the United States a date-growing region. This enterprise, one of the most notable of the many plant introductions made by the

Department, has met with such success that a California concern last year sent two men to secure a large quantity of date plants from Arabia and Africa. They returned to the United States a short time ago with a consignment of no less than 9,000 plants.

As the imported varieties came into fruiting in the United States, the natural ripening of the fruit was not found satisfactory and experiments were therefore started to ascertain whether or not the fruit could be ripened artificially. The problem has now been solved, the immature fruit being cured in ovens with a raised temperature.

Thus, when humidity is no longer a barrier, it would seem that we may in the future see date culture extended to many regions of the earth where heretofore its culture, commercially speaking, has been an impossibility. Some 75 date seedlings are being planted at the Lamao experiment station.

PERIODICALS RECEIVED IN THE BUREAU OF AGRICULTURE LIBRARY.

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Agricultor Practico, Guantanamo, Cuba.
Agricultural Blaster, Wilmington.
Agricultural Bulletin of the Federated Malay States.
Agricultural Gazette of New South Wales, Australia.
Agricultural Gazette of Tasmania, Australia.
Agricultural Journal of India, Calcutta.
Agricultural Journal of the Mozambique Company, Portuguese East Africa.
Agricultural Journal of the Union of South Africa, Pretoria.
Agricultural News, Barbados.
(L') Agronomie Tropicale, Uccle, Belgium.
American Breeders Magazine, Washington.
American Florist, Chicago.
American Forestry, Washington.
American Journal of Public Health, New York.
American Journal of Veterinary Medicine, Chicago.
American Poultry Advocate, New York.
American Poultry Journal, Chicago.
American Sugar Industry and Beet Sugar Gazette, Chicago.
American Thresherman, Madison.
American Veterinary Review, New York.
Anglo Japanese Trade Journal, London. (Japanese edition of British Trade Journal.)
Angora Goat Breeders Journal, Portland.
Annals of the Entomological Society of America, Columbus.
Archiv für Wissenschaftliche und Praktische Tierheilkunde, Berlin.
Australian Meat Trades' Journal, Sydney.
Australian Meat Trades' Journal and Chilling Depots, Sydney.
Berliner Tierarztliche Wochenschrift, Berlin.
Boletin de la Asociación de Labradores, Zaragoza, Spain.
Boletin de la Biblioteca Municipal de Guayaquil, Equador.
Boletin de Bosques, Pesca y Caza, Santiago, Chile.
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Boletim do Departamento Estadual do Trabalho, São Paulo.
Boletin de la Dirección General de Agricultura, Mexico.
Boletin de Fomento, San José, Costa Rica.
Boletin del Ministerio de Agricultura, Buenos Aires.
Boletin Oficial de la Secretaria de Agricultura, Havana.
Bollettino Tecnico della Coltivazione dei Tabacchi, Scafate, Italy.
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Breeders' Gazette, Chicago.

British Trade Journal, London.
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Bulletin de la Chambre de Commerce de Saigon.
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Bulletin Economique de l'Indochine, Hanoi-Haiphong.
Bulletin du Jardin Botanique de Buitenzorg, Java.
Bulletin of the Department of Agriculture, Jamaica.
Bulletin of Entomological Research, London.
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Bulletin of the Pan-American Union, Washington.
Bulletin of the Philippine Library, Manila.
Bulletin de la Societé Royale de Botanique de Belgique, Bruxelles.
Business America, New York.
California Cultivator, San Francisco.
Canadian Entomologist, Guelph, Ontario.
Centralblatt fur Allegemeine Pathologie und Pathologische Anatomie, Jena.
Centralblatt fur Bakteriologie, Originale, Jena.
Centralblatt fur Bakteriologie, Referate, Jena.
Chacaras e Quintaes, São Paulo.
City of Denver.
Climatological Service of the Weather Bureau. Colorado section.
Colorado Dairyman, Fort Collins.
Comercio, New York.
Commercial America, Philadelphia.
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Cordage Trade Journal, New York.
Country Gentleman, Philadelphia.
Criador Paulista, São Paulo.
Crop Reporter, Washington.
Cuba Magazine, Havana.
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Cuban American, Gloria.
(El) Cultivador Moderno, Barcelona.
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(L') Expansion Colonial Bulletin de L'Institute Colonial Marseillais.
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Far East, Tokyo.
Far Eastern Review, Shanghai.
Farm Journal, Philadelphia.
Farm Life and Agricultural Epitomist, Spencer.

Farmer's Guide, Huntington.
(O) Fazendeiro, São Paulo.
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Fiji Planters' Journal, Suva.
Filipino People, Washington.
Florida Grower, Tampa.
Formosan Agricultural Review, Taihoku (in Japanese).
Gardeners' Chronicle, London.
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India Rubber World, New York.
Indian Textile Journal, Bombay.
(L') Institut Pasteur, Annales, Paris.
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International Confectioner, New York.
International Sugar Journal, Manchester.
Japan Magazine, Tokyo.
Japan Weekly Mail, Tokyo.
Journal d'Agriculture Tropicale, Paris.
Journal de Medecine Veterinaire, Lyon.
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Journal of the American Medical Association, Chicago.
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Journal of Economic Entomology, Melrose Highlands.
Journal of Experimental Medicine, Appleton.
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Louisiana Planter and Sugar Manufacturer, New Orleans.
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Mining Science, Denver.
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Monthly Bulletin, State Commission of Horticulture, San Francisco.
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Mulford's Veterinary Bulletin, Philadelphia.
National Geographical Magazine, Washington.
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North Queensland Register, Townsville.
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Oklahoma Farm Journal.
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Petaluma Weekly Poultry Journal, California.
(Der) Pflanzer, East Africa.
Philippine Agricultural Review, Manila.
Philippine Agriculturist and Forester, Los Baños.
Philippine Craftsman, Manila.
Philippine Craftsman Reprint Series, Manila.
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Philippine Islands, Bureau of Health, Quarterly Report, Manila.
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Philippine Free Press, Manila.
Philippine Journal of Science, A. Chemical and Geological, Manila.
Philippine Journal Science, B. Medical Sciences, Manila.

Philippine Journal of Science, C. Botany, Manila.
Philippine Journal of Science, D. Ethnology, Anthropology and General Biology, Manila.
Philippines Monthly, Manila.
Philippines Observer, Manila.
Porto Rico Progress, S. Juan.
Posselt's Textile Journal, Philadelphia.
Poultry, Peotone, Illinois.
Poultry Review, Elmira, N. Y.
Proceedings of the Agricultural Society of Trinidad and Tobago, West Indies.
Progressive Farmer, Raleigh.
Queensland Agricultural Journal, Brisbane.
Recueil de Medecine Vétérinaire, Paris.
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Renacimiento Filipino, Manila.
Resumen de Agricultura, Barcelona.
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Revista de la Asociación Rural, Montivedeo.
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Revista del Instituto Agricola Catalán de San Isidro, Spain.
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Revista Nacional de Colombia, Bogota.
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Riqueza Agricola, Lima.
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Rural California, Los Angeles.
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Sarawak Government Gazette, Kuching, Borneo.
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Tropical Veterinary Bulletin, London.
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United States Department of Agriculture, Weather Bureau, Monthly Summary.
United States Experiment Station Record.

United States Farmers' Bulletin.
Veroffentlichunger des Kaiferlichen Gefundheitsamts, Berlin.
(La) Vie Agricole et Rurale, Paris.
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Wealth of India, Madras.
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Weekly Statistical Sugar Trade Journal, New York.
West India Committee Circular, London.
West Indian Bulletin, Barbados.
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Zeitschrift fur Tiermedizin, Jena.
Zeitschrift fur Veterinarekunde, Berlin.

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TEMPERATURE AND RAINFALL FOR AGRICULTURAL DISTRICTS IN THE PHILIPPINES.

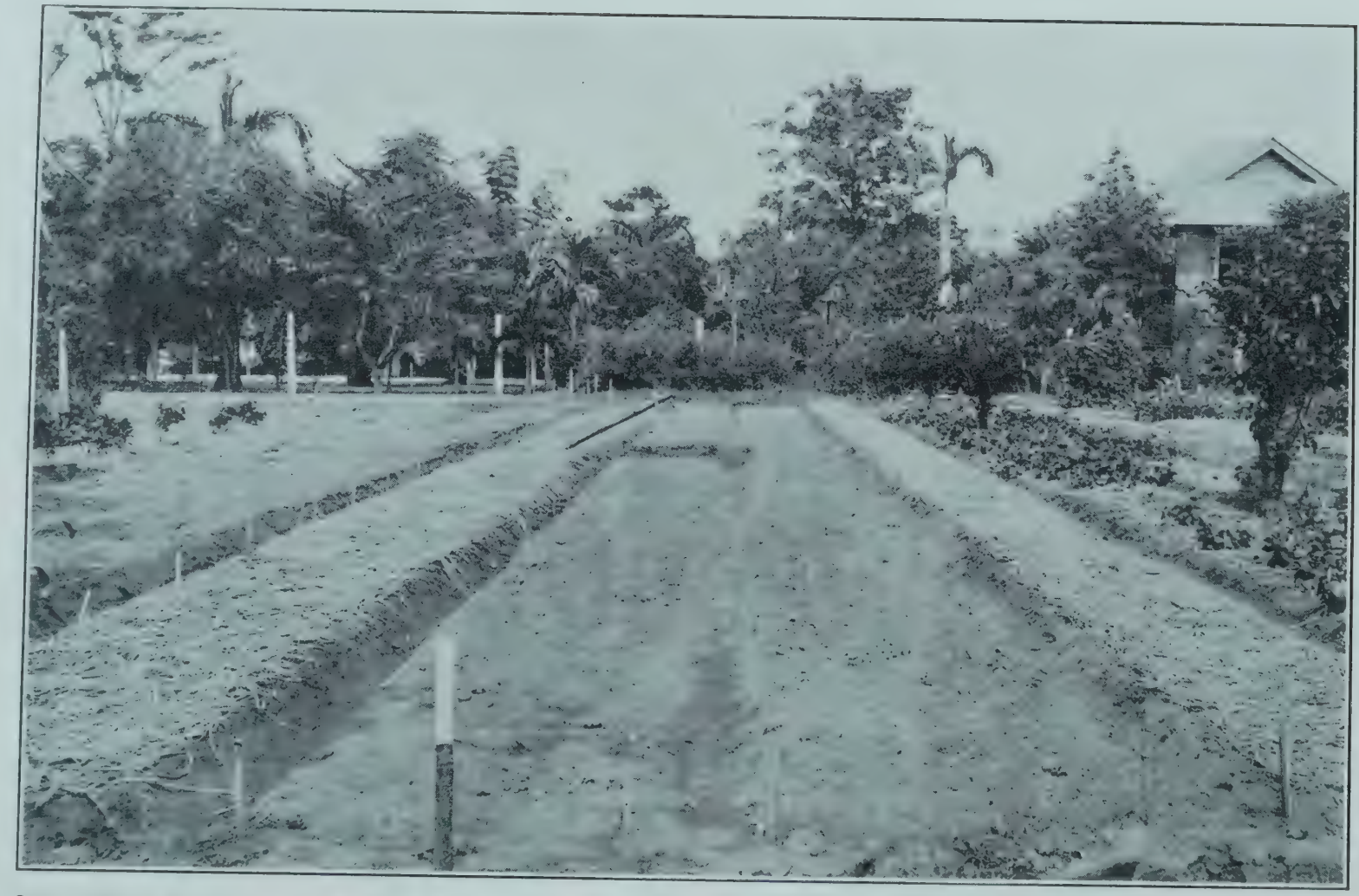
By the DIRECTOR OF THE WEATHER BUREAU.

August, 1913.

[Temperature and total rainfall for 24 hours beginning at 6 a. m. each day.]

Date.	Abacá (Manila hemp).				Sugar, Iloilo.		Rice, Tarlac.		Tobacco.			
	Albay.		Tacloban.						Aparri.		San Fernando.	
	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.
	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.	°C.	mm.
1	26.3	34	27.4	2.6	27.6	21.5	26.5	10.1	27.4	7.9	27.2	3.3
2	27	6.1	28	-------	27	26.7	26.8	-------	27	-------	27.9	.5
3	27.6	-------	28.3	-------	27.8	1	26.2	2.5	27.6	-------	28.4	5.3
4	26.6	3.3	28	3.8	28	17	25.7	20.4	27.6	-------	27.4	24.2
5	26.2	13.3	26.9	1.1	26.4	101.6	26.2	18.3	26.8	-------	27.6	5.1
6	25.6	15.5	27.7	-------	25.4	39.4	27.6	17.7	27.1	-------	28.9	6.9
7	26.8	1	28.4	.3	25.7	8.8	26.8	32	26.9	1.3	28.8	35.8
8	28	-------	27.7	-------	27.2	-------	25.4	27.9	27.9	-------	26.2	2
9	27.8	-------	28.1	27.4	26.5	-------	28.1	-------	28	-------	27.9	11.9
10	27.7	-------	28	-------	27.8	-------	28.2	11.2	28.2	2	27.2	54.3
11	27.2	-------	28	-------	27.4	-------	28.4	8.4	27	1.8	27.4	12.2
12	27.2	17.5	26.6	17	26.8	10.2	27.2	32.5	27	.8	27.4	5.3
13	26.7	31.6	25.2	11.8	26.9	-------	27.2	-------	27.9	-------	27.1	.8
14	25.3	5.4	26.3	6.1	26.4	-------	27.4	6.9	28	-------	27.4	39.6
15	26.8	2.1	28.3	-------	26.2	36.4	27.5	5.1	27.4	42.7	27.4	73.6
16	27.4	3.8	27.5	.3	26.5	.5	24	7.3	24.9	17.8	24.4	120.9
17	26.7	-------	26.8	.5	26.8	19.8	27.9	-------	27.4	-------	27.4	-------
18	28.3	.3	26.4	4.3	26.7	4.5	29	-------	27.7	8.1	28.4	-------
19	28	13.9	26.8	8.7	27.1	1	29.6	45.2	27	.5	29.2	1
20	26	1.3	26.8	3.8	26.6	2	27.4	22.9	26.9	7.9	27.8	17
21	27.1	1.5	25.8	.5	26.5	6.1	27.5	9.7	27.2	-------	27.3	1
22	26.7	1.1	26.6	1.3	26.4	25.4	27	-------	27.9	-------	28.4	5.3
23	26.2	10.2	27.4	9.7	25.2	43.7	27.4	7.6	27.8	-------	28.2	3.3
24	26.8	22.9	26.4	1	25.2	9.3	27.8	8.1	27.9	-------	27.8	3.6
25	27.2	5.6	26.3	5.6	26.5	-------	26.2	38.9	28.1	-------	28.1	85.1
26	26.9	2.6	27.4	-------	26.8	20.6	26.6	12.9	27.8	-------	27.5	16.8
27	26.8	1.3	27.5	13.2	25.6	65	26.9	.8	28	-------	27.5	3.6
28	26.5	-------	26.5	-------	24.8	40.7	27	3	28.5	-------	28	4.1
29	26.9	-------	26.9	2.8	26.7	1	26.4	-------	29	-------	28.4	-------
30	27.1	.8	27.1	-------	26.4	1.5	27.2	4.8	28.6	-------	28.3	9.4
31	26.4	-------	24.8	36.8	25.9	2.3	28.4	3.8	27.6	6.9	27.6	-------

PLATE I.



Comparative-test vegetable plats at the Singalong experiment station. Presumably acclimatizable vegetable varieties are tried out here before being distributed.

ANNUAL REPORT 1912–13

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CONTENTS.

	Page.
General agricultural conditions	585
Bureau of Agriculture	587
General statement	587
Personnel	590
Division of animal husbandry	591
Purchase and sale of animals	591
Experimental breeding	591
Feeds and feeding	592
Feeding tests with papayas	592
Kapok seed meal feeding test	593
Forage crops	593
Alabang stock farm	594
Forage crops	594
Silo	595
Trinidad stock farm	596
Public breeding project	596
Catanduanes	597
Batangas	597
Temporary stations	598
Oriental Negros	598
Horse project	598
Alabang	598
La Carlota	599

Division of animal husbandry—Continued. Page.
Cattle project ... 599
Alabang ... 599
La Carlota ... 600
Trinidad ... 600
Swine project ... 600
Goat project ... 601
Sheep project ... 602
Veterinary division ... 602
Personnel ... 602
Animal-disease eradication ... 602
Rinderpest ... 602
Iloilo-Capiz-Antique ... 603
Leyte ... 603
Pampanga ... 604
Bulacan ... 604
Ambos Camarines ... 604
Agusan ... 604
Bohol ... 605
Cagayan ... 605
Cavite ... 605
Ilocos Norte ... 605
Ilocos Sur ... 606
La Union ... 606
Amburayan Subprovince ... 606
Pangasinan ... 607
Rizal ... 607
Surigao ... 607
Zambales ... 607
Quarantines ... 607
Cases and deaths ... 608
Foot-and-mouth disease ... 609
Surra ... 609
Glanders ... 609
Contagious pleuropneumonia ... 610
Miscellaneous diseases ... 610
Philippine Scouts and Constabulary on duty June 30, 1913 ... 610
Importation from foreign ports ... 611
Quarantine stations ... 611
Pandacan quarantine station ... 611
Simultaneous inoculation ... 612
Iloilo quarantine station ... 612
Sisiman matadero ... 612
San Lazaro station ... 612
Interisland shipments ... 612
Inspections ... 613
Inspections for which fees were charged ... 613
Post-morten inspection in Manila matadero ... 613
Research work ... 616
Division of agronomy ... 614
Rice ... 615
Maize ... 615
Sugar cane ... 616
Grasses and forage crops ... 617
La Carlota experiment station ... 617
Sugar-cane experiment No. 1 ... 617
Sugar-cane experiment No. 2 ... 617
Sugar-cane experiment No. 3 ... 618
Sugar-cane experiment No. 4 ... 618
Division of horticulture ... 619
Singalong experiment station ... 620
Lamao experiment station ... 621
Ilagan tobacco station ... 624
Seed and plant distribution ... 624
Banana and tropical-fruit collection ... 625

Division of horticulture—Continued. Page.
Tropical-fruit investigations ... 626
Root crops and vegetables ... 627
Spices ... 627
Apiculture ... 628
Locust extermination ... 628
Miscellaneous entomological work ... 629
Fiber division ... 630
Abacá (Manila hemp) ... 630
Abacá varieties ... 630
Cultural methods ... 631
Quality of the fiber ... 631
Effect of 1912 drought and typhoons on production and value of abacá ... 633
Abacá machines ... 633
Knotted abacá ... 634
Agave and allied fibers ... 634
Maguey (cantala) and sisal ... 634
Distribution of suckers and bulbils ... 634
Production and value ... 634
Enemies and diseases ... 634
Agave and Furcroea introduction ... 635
Kapok ... 635
Status of the industry ... 635
Cotton ... 635
American upland cotton ... 636
Native species ... 636
Caravonica cottons ... 637
Conclusions ... 637
Miscellaneous fibers ... 637
China grass (*Boehmeria nivea*) ... 638
Roselle (*Hibiscus sabdariffa*) ... 638
Hibiscus cannabinus ... 638
Carludovica palmata ... 638
Anabú (*Abroma augusta*) ... 638
Sansevierias ... 638
Ticog (*Fimbristylis utilis*) ... 639
Demonstration and extension division ... 639
Iloilo–Capiz demonstration project ... 639
Cebu demonstration project ... 641
Batangas demonstration project ... 641
Mountain Province demonstration project ... 642
Rizal–Laguna–Cavite demonstration project ... 643
Agricultural demonstration car ... 643
Distribution of publications ... 643
Division of publications ... 644
The Philippine Agricultural Review ... 644
Bulletins and circulars ... 645
Planotype ... 646
Library ... 646
Division of statistics ... 646
Division of machinery and construction ... 647
Pandacan forage factory ... 647
Pandacan repair shop ... 648
Steam and motor plowing ... 648
General and statistical tables ... 649
No. 1. List of directing and supervising officers ... 649
No. 2. Inspections at the port of Manila for the fiscal year ending June 30, 1913 ... 649
No. 3. Inspections at port and city of Manila during fiscal year ending June 30, 1913 ... 650
No. 4. Live-stock report of inspections port and city of Manila during fiscal year ending June 30, 1913 ... 650
No. 5. Post-mortem inspections in Manila abattoir during fiscal year ending June 30, 1913 ... 650
No. 6. Condemnations in Manila abattoir during fiscal year ending June 30, 1913 ... 651
No. 7. Total cases and deaths from various diseases during fiscal year ending June 30, 1913 ... 652

General and statistical tables—Continued. Page.
No. 8. Live stock passing through Pandacan quarantine station during fiscal year ending June 30, 1913 655
No. 9. Post-mortem inspections in Sisiman abattoir during fiscal year ending June 30, 1913 655
No. 10. Live-stock purchases for Government branches other than the Bureau of Agriculture 656
No. 11. Sale of Bureau animals 656
No. 12. Summary of public breeding 658
No. 13. Bureau animals born during the year 658
No. 14. Deaths of Bureau animals during the year 659
No. 15. Number and location of Bureau animals at end of year 659
No. 16. Distribution of Philippine Agricultural Review, fiscal year 1912–13 660
No. 17. Complete mailing list of the Philippine Agricultural Review 660
No. 18. Cost of publishing and delivering the Philippine Agricultural Review, fiscal year 1912–13 660
No. 19. Paid subscriptions to Philippine Agricultural Review, fiscal year 1912–13 661
No. 20. Planotype work, fiscal year 1912–13 661

ILLUSTRATIONS.

PLATE I. Comparative test vegetable plats at the Singalong experiment station. Presumably acclimatizable vegetable varieties are tried out here before being distributed ..... *Frontispiece.*

Facing page—

II. Good type of Grade or "Mestizo" stallion. Alabang stock farm 594
III. Pure-bred Berkshire Boar. Type used in Pure-bred and Public-breeding work 594
IV. Simultaneous inoculation at Iloilo, 1912. Inspector taking notes 610
V. Isolation of animals in a barrio infected with rinderpest 610
VI. Corral for the isolation of animals infected with rinderpest 610
VII. Moro maize at Singalong experiment station yielding 9,750 liters per hectare 626
VIII. Mungo grown as a cover crop in rice field during dry season 626
IX. Propagating house at the Singalong experiment station; for valuable plants which require special treatment (constant humidity and even temperature) 626
X. (*a*) Mangosteen (*Garcinia mangostana*); Dumaguete, Oriental Negros. The world's best fruit. (*b*) Siamese seedless pomelo (*Citrus decumana*); recently introduced from Siam. One of the excellent varieties which, it is believed, will revolutionize the pomelo industry of the world 626
XI. Abacá plant, 15 months old, "Bangulanon" variety of southeastern Mindanao, reproduced from rootstock. La Carlota experiment station, Occidental Negros 642
XII. Abacá plant, "Laguis" variety of northeastern Leyte, 11 months old, reproduced from rootstock. La Carlota experiment station, Occidental Negros 642
XIII. Kidney cotton plant (native "toguillo"), 5 months old. La Carlota experiment station, Occidental Negros 642
XIV. Maize plot at the Santa Cruz demonstration station 642
XV. Endive and onion plots at the Santa Cruz demonstration station 642

ANNUAL REPORT OF THE BUREAU OF AGRICULTURE.

GENERAL AGRICULTURAL CONDITIONS.

The rice crop of the past year, including the main crop harvested in December, 1912, and the short-season crop which has just been harvested, was the heaviest recorded in many years. It is estimated that the rice crop of the fiscal year 1913 was fully 100 per cent greater than the crop of the previous year. The high prices received for the rice crop of the fiscal year 1912 resulted in the planting of a largely increased area, and favorable climatic conditions prevailed throughout the rice-growing season. As a direct result of this bumper crop, there was a decrease of more than 80 million kilos, or about 5 million pesos in value, in rice imports, and conditions throughout the principal rice-growing provinces have been good. The distribution by the Bureau of Agriculture of selected and tested seed, of varieties of rice that have produced an average yield of 2,000 kilos or more per hectare, has served to stimulate an interest on the part of the planters in the use of good seed of this important crop.

A reflex of the short rice crop of the previous year has been noticed in the large maize crop of this past season. The campaign to popularize maize called the attention of the people to its value, and many turned to it as a substitute food supply during the shortage of rice. Many farmers are now growing maize as a regular crop in addition to rice. It is important that further action be taken to develop the use of maize as a human food, in order that the farmers may be able to dispose of their increased crops.

The grinding of the sugar crop was finished rather late this year, as the growth of the cane was retarded by the dry weather during the early part of the season. The quality of sugar produced by the small mills classified rather low which was somewhat disappointing to the planters. Continued low prices have also been discouraging, but the present condition of the sugar crop is good and a better feeling now prevails. Several new centrals have been erected or contracted for during the year. Sugar

exports for the fiscal year 1913 showed an increase of approximately 30 million kilos, but a decrease of nearly 2 million pesos in value, over the previous year.

The copra crop suffered very severely from the phenomenal drought of the previous year and the typhoons of this year. The Visayas and Mindanao have not been quite so badly affected, but the output of certain districts in Laguna and Tayabas in Luzon have been reduced by about one-half in some cases. The falling off in bulk of the exported product, 113,000 tons against 169,000 tons in 1912, has been about 33 per cent. The good prices have helped somewhat to offset this reduction in quantity, the value of the exports for the past year being 23 million pesos, or about 28 per cent less than the previous year. On account of the high price of abacá, copra has not been able to maintain the ascendancy, gained once during the previous year, over the fiber crop which still ranks first among Philippine exports.

None of the coconut plantations have actually been lost, however, and the trees are now carrying almost the normal number of fruits. Considering the fact that it requires about twelve months between flower and mature fruit, the prospects for the coming year are good. Copra prices have held firm throughout the year. The new feature of artificially drying copra without direct contact of smoke with the "meat" is slowly but surely gaining ground; there are at least three private concerns turning out smokeless copra by means of dryers using either steam pipe, or flues, to furnish heat, and several others will probably install plants soon.

The tobacco crop of the past year was not particularly good, but the results of the 1912 drought have now practically disappeared. Throughout the year the traveling inspectors in the Cagayan Valley under control of the tobacco station at Ilagan have urged the multiple-crop system among the Filipino planters. This work is beginning to show good results and the system of tobacco or nothing is fortunately growing in disfavor. The production of leaf in Luzon is estimated at 30,500 tons as against 28,000 tons for the previous year. It is in the export cigar trade that the tobacco prosperity displays itself; this item has exceeded that of 1912 by over 60 per cent; 288 millions (worth ₱6,700,000) against 175 millions for the previous year—an unprecedented annual increase. The export of leaf and miscellaneous tobaccos is also rapidly increasing and has amounted to over 4 million pesos this year.

The policy of winnowing the tobacco seed gratis for small planters has gained in favor and 12 municipally owned machines

are now in evidence in the Cagayan Valley. The Bureaus of Internal Revenue and Agriculture appear to have finally instilled into the minds of the planters the necessity for erecting proper curing sheds for the raw crop; this feature not only prevents losses but insures better quality in the cured bales.

During the year the exports of abacá (Manila hemp) amounted to 144,576 metric tons, or about 6 per cent less than the previous year, in quantity, and to ₱46,089,488, or 41.5 per cent more than the previous year, in value. The value of this year's exports of abacá, therefore, not only makes this crop the banner export crop for the year but also marks the highest point which it has reached in the history of the industry, the value of the exports of 1905, amounting to ₱44,292,482, being the highest point reached prior to this year. The quality of the abacá fiber as well as the cultural methods practiced throughout the provinces remain unchanged, or perhaps with a tendency to the worse. The effect of the drought and typhoons of 1912 on the production of abacá became evident during January and February, and it is estimated that the production during the fiscal year 1914 will range between 110 and 120 thousand metric tons.

The condition of the maguey industry remains practically unchanged. The production of fiber during the year, however, has considerably increased, both in quantity and in value, owing to the recent rise in the value of all hard fibers. The exports of maguey for the year were 8,336 metric tons, valued at ₱1,408,788, or an increase of 3,843 tons (or about 84 per cent in quantity) and ₱766,846 (or about 119 per cent in value) over the exports of last year. There has been a tendency on the part of the maguey producers to increase the areas cultivated and it is hoped that this will be supplemented by an attempt to introduce machinery to replace the present retting method for cleaning the fiber.

The kapok industry has also exhibited encouraging signs of improvement during the year, chief among which are the establishment of several medium-sized and large plantations in Central Luzon. These are being managed in an up-to-date manner and with the ultimate view of using machinery for cleaning and baling the floss.

BUREAU OF AGRICULTURE.

GENERAL STATEMENT.

The work of the Bureau of Agriculture covers four general lines of activity, viz, administration, public services, investigation, and dissemination of information. Definite progress has

been made and substantial results have been obtained during the past year in each of these departments. With a rinderpest campaign that has required the expenditure of approximately two-thirds of the total appropriation, and with a general locust infestation throughout the Archipelago, the resources of the Bureau have been severely taxed. It has been possible, however, not only to carry on this defensive work against pests and diseases on a larger scale and with more activity than heretofore, but also to establish various important lines of constructive work, and to close the year with a considerable surplus to the credit of the Bureau's appropriation. Certain features of the work of the Bureau during the past year are deserving of special comment.

On July 1, 1912, the entire work of the Bureau of Agriculture was placed under a project system, the general features of which were outlined in the last annual report. This system of organization placed a definite responsibility on each employee, provided a definite allotment for each line of work, and insured a complete and accurate record of all work done. The operation of the project system has been highly satisfactory and its use has resulted in a marked improvement in both organization and administration.

Of what may be termed the public services of the Bureau of Agriculture, the most important is the campaign against rinderpest. The strict enforcement of quarantine regulations has prevented the introduction of disease from foreign countries. The measures used in eradicating rinderpest infection existent within the Archipelago have resulted in the cleaning up of all infected territory in the Visayas, northern Mindanao, and southern Luzon. The number of infected provinces has been reduced from 11 to 8, and of infected municipalities from 34 to 23. At the close of the year there was no known rinderpest infection in the Philippine Islands south of the city of Manila.

One of the most serious and difficult problems of the year's work has been the control of a locust infestation that has covered practically the entire Archipelago. Under the provisions of Act No. 2121 of the Philippine Legislature the disbursement of Insular funds appropriated for the extermination of locusts, and the organization and control of the locust campaign is delegated to the Bureau of Agriculture. During the past year it has been necessary to detail six employees on this work. A locust board has been appointed in each province, funds and supplies have been furnished the infested districts, regulations governing the

methods of operation and detailed information regarding locust eradication have been widely disseminated, and in different districts employees of the Bureau have taken direct charge of the campaign. At the close of the year the infestation, though still widespread, is fairly well under control. The work is now well organized, and funds and supplies are available in all infested provinces.

The improvement of the live stock of the Islands by the production, sale, and loan of breeding animals has made satisfactory progress. A total of 288 animals have been born at the different farms of the Bureau. One hundred and ten animals have been sold, a large part of which will be used for breeding purposes. Twenty-seven stallions and five bulls are now being used by the Bureau for public live-stock breeding in the provinces. There is a larger demand for good stallions, bulls, and boars than the Bureau is able to supply from its own farms, and an order has been recently placed in the United States for 57 head of breeding stock.

The demand for selected seeds and plants continues to increase each year. During the past year the Bureau has mailed 12,000 collections, containing about 125,000 separate packages of seeds. More than 600 similar collections have been distributed from the Central Office, and large quantities of seed in bulk have been furnished provincial governors, supervising teachers, and farmers coöperating with the Bureau. Some 30,000 mulberry cuttings, 28,000 sisal bulbs, 1,000 pineapples suckers, and other miscellaneous plants have also been distributed. The seed and plant distribution work of the Bureau reaches practically every municipality in the Archipelago, and is an important factor in agricultural improvement.

Among the more important lines of investigational work should be mentioned that of the veterinary pathologist and entomologist. The completed work of these investigators is covered by fourteen papers published or completed for publication during the year, the titles of which are given in this report. The important rice investigations that have been carried on for five years with more than 1,000 local varieties of rice have now reached a point that makes possible the distribution of seed of selected and thoroughly tested varieties. Investigations with maize have developed the fact that two of the local varieties give better results under local conditions than any varieties yet imported. All of the principal varieties of abacá from the more important abacá-producing provinces have been collected and planted in experimental plats at

the La Carlota station. As the future development of the abacá industry must be based on the determination of the best varieties, this work should be of great value. Similar work with both imported and local varieties of cotton is now being carried on at La Carlota.

At the Singalong experiment station more than 1,000 varieties of vegetables and forage plants have been tested during the year. At the Alabang farm 134 varieties of bananas have been permanently set in the trial plats. At the Lamao station important investigational work has been carried on with the anonas, citrus fruits, pineapples, avocados, mangos, papayas, and other fruits and vegetables.

In order that the information obtained by the Bureau in its investigational work may be utilized by the farmers in producing larger and better crops, it is essential that this information be widely disseminated. The publications issued during the year include thirteen numbers of the Philippine Agricultural Review (the last annual report of the Bureau was published as a special number of the Review), five bulletins, seven circulars, and three reprints.

The method of promoting agricultural development by taking information directly to the farmers, and demonstrating the value of improved methods on the farms, is now a prominent feature of the work of the Bureau. The coöperative demonstration work has been thoroughly organized during the past year, and definite results have already been obtained.

PERSONNEL.

The Director of Agriculture departed for the United States on April 20, 1913, for an official trip in connection with the affairs of this Bureau and those of the Panama-Pacific International Exposition, and has been absent from the Philippine Islands since that date. During this period of absence of the Director, Mr. H. T. Edwards, Assistant to the Director, has been in charge of the work of the Bureau as Acting Director. Mr. C. M. Conner was appointed chief, division of agronomy, effective July 1, 1912. Dr. Frank C. Gearhart resigned the position of chief, division of animal husbandry, on March 5, 1913. Mr. C. W. Edwards, animal husbandman, was designated acting chief of the division of animal husbandry on March 6, 1913, and served until May 1, 1913, when he was permanently appointed chief of the division. Mr. Benjamin P. Lukens was appointed chief, division of statistics, on January 1, 1913. Mr.

Lukens, up to that date, had been acting chief of that division. Mr. Zalmon K. Miller resigned the position of chief, division of machinery and construction, on January 4, 1913. This position has not been permanently filled since that date.

During the fiscal year 9 Americans have been appointed to classified positions and 11 have been separated by resignation and transfer, a net decrease of 2. Thirty Filipinos were appointed to classified positions and 6 were separated by resignation and transfer, a net increase of 24.

The number of Americans temporarily employed was slightly less than that for the preceding year, while the number of temporary Filipino employees was increased materially.

DIVISION OF ANIMAL HUSBANDRY.

PURCHASE AND SALE OF ANIMALS.

This project covers the purchase within the Islands of all animals for the various branches of the Insular Government and for the city of Manila, and the sale of animals belonging to the Bureau of Agriculture.

Forty-eight purchases, including 311 animals, and 59 sales, including 112 animals, were made during the year. The total amount paid for animals purchased was ₱21,509, of which ₱11,280 was for the Bureau of Agriculture and ₱10,229 was for other branches of the Government. The total sales of Bureau of Agriculture breeding stock amounted to ₱7,280, and ₱624.50 was received as a surcharge on the purchase of live stock for other branches of the Government. For complete data on this subject see Tables 12 and 13 (appendix).

On March 11, 1913, an order was placed for the following animals to be purchased in the United States:

Swine: 4 Duroc-Jersey sows, 4 Duroc-Jersey boars, 4 Yorkshire sows, 4 Yorkshire boars, 10 Berkshire sows, 10 Berkshire boars.
Stallions: 5 standard or thoroughbred stallions.
Goats: 5 billies under 18 months.
Cattle: 10 pure-bred Hereford heifers, 5 pure-bred Hereford bulls.

EXPERIMENTAL BREEDING.

The entire work of the production of breeding animals, where the process involves the introduction of foreign blood, may be considered of an experimental nature. As limited funds are available for this work the greater part of the data of this project must be obtained in connection with the work of production. However, there is one phase of purely experimental work the importance of which is considered sufficient to war-

rant its undertaking at this time, i. e., the determination to what extent the size and general conformation of the native horse can be improved without the introduction of foreign blood. With this end in view, 22 large native mares of good conformation were selected to be bred to "Carbonero" No. 44, a native stallion 54 inches in height and of superior conformation.

The experiment was begun March 3, 1911, at which time the following mares were assigned to this project: A–26, B–2, B–53, B–87, B–94, 33, 47, 68, 90, 96, 45, 99, 108, 112, 113, 114, 115, 178, 179, 180, 182, 254.

Out of the total number of mares assigned to this project, 14 dropped foals during the year, sired by "Carbonero;" of the remainder 3 were considered in foal at the end of the year, and 1, No. 114, was assigned to stallion "Hamayoon."

FEEDS AND FEEDING.

The object of this project is to ascertain the comparative values of different feeds and feeding combinations for different classes of live stock and poultry fed under various conditions; and to determine the adaptability and cost of production of feeds grown on various soils and under different conditions.

Feeding tests with papayas.—During the second quarter there was partially concluded at Alabang a hog-feeding test with papayas. The test was not fully completed, owing to the lack of papayas, the trees being destroyed by the wet season and typhoons. A more extensive test will be made during the coming year.

Two hundred and seventy-nine trees yielded a total weight of 1,251.05 kilos during the period between July and October. This probably was not more than half the weight they should have yielded in that period of time under ordinary conditions.

In the test the pens were divided as follows:

Pen I contained 3 young sows. They were fed a gradually increasing ration of Pandacan mixed feed No. 14.

Pen II contained 3 young sows. They were fed a ration of Pandacan mixed feed No. 14, and as much papaya as they would eat each day.

Pen III contained but 2 sows. These animals were fed a ration of Pandacan mixed feed No. 14, and as much papaya as they would eat each day.

Pen IV contained 2 sows. An attempt was made to feed only papayas to this pen. The Pandacan mixed feed was gradually reduced and the ration of papayas increased until at the end

of two weeks papaya alone was being fed. The pigs, however, showed a disinclination to eat the straight papaya ration, so a small quantity of the mixed feed, amounting to 0.3 kilo per day per head, was added to the ration.

In comparing the data obtained in this test it was noted that the total individual increase and, in nearly every case, the daily gain per animal were materially increased by substituting papaya for a portion of the grain ration, while the results obtained with Lots III and IV would seem to indicate that a practically entire ration of papaya will not give nearly as satisfactory gains as when the papaya is combined with even a small amount of grain.

Although this test was not of sufficient duration to consider the results as conclusive, they indicate very strongly that papayas when combined with other components form a valuable swine feed.

Kapok-seed meal feeding test.—During the first half of the present fiscal year a feeding test with kapok-seed meal was carried out at Alabang, the purpose of which was to determine the value of this meal as a ration for cattle. First, only a preliminary test was undertaken with 3 steers, and no evil effects being discovered, a larger test was undertaken with 12 bullocks, Nos. 39, 54, 684, 701, 853, and 2473 in one division and Nos. 24, 706, 719, 735, 843 and 1977 in the other. The first lot were fed the usual ration and the second lot started on a ration of $2\frac{1}{2}$ kilos of oats and one-half kilo of kapok-seed meal, with 30 kilos of green forage in addition to the pasturage.

The results of this test tend to show that kapok-seed meal may form a valuable adjunct feed for cattle, although it is a fat rather than a muscle-producing feed and could perhaps be used more advantageously in finishing cattle for market than for the feeding of work cattle.

When fed to swine it was found that the meal had a poisonous effect.

Forage crops.—At Trinidad, oats proved to be the most satisfactory green forage crop grown during the year, one crop sown in December giving three very heavy cuttings during a period of about eight and one-half months. The experience at this station the past season indicates very strongly that oats may serve as a very good green forage crop for some of the northern provinces. The sorghum sown at this station did very poorly.

Among the improved pasture grasses experimented with the paspalum (*Paspalum dilatatum*) has proven by far the most sat-

isfactory. Two fields of approximately 1.5 hectares each planted some two years ago are now in the permanent pasture stage, being entirely covered with a heavy closed sod, which adds very materially to the stock-carrying capacity of the station. At this station this grass appears to withstand the rigors of dry and wet seasons alike. A considerable portion of the lowland native-grass pastures have been planted (by settings) to paspalum. This appears to be a successful method of pasture improvement as the settings stool properly crowding out the less desirable native grasses. During the coming rainy season an attempt will be made to improve a portion of the upland or clay hill pastures in this manner.

At the Bicol farm, Virac, Catanduanes, a sufficient amount of green forage has been raised to meet the demands of the station and to supply the public with a large amount of seed. Japanese millet has been successfully grown at this place, and it is reported that the people have become very much interested in the crop.

At the Batangas breeding station, of the 6 hectares under cultivation about one-half is devoted to the growing of Rhodes grass, Guinea grass, corn, and such legumes as guar and canavalia. These are reported as having given very satisfactory growths.

ALABANG STOCK FARM.

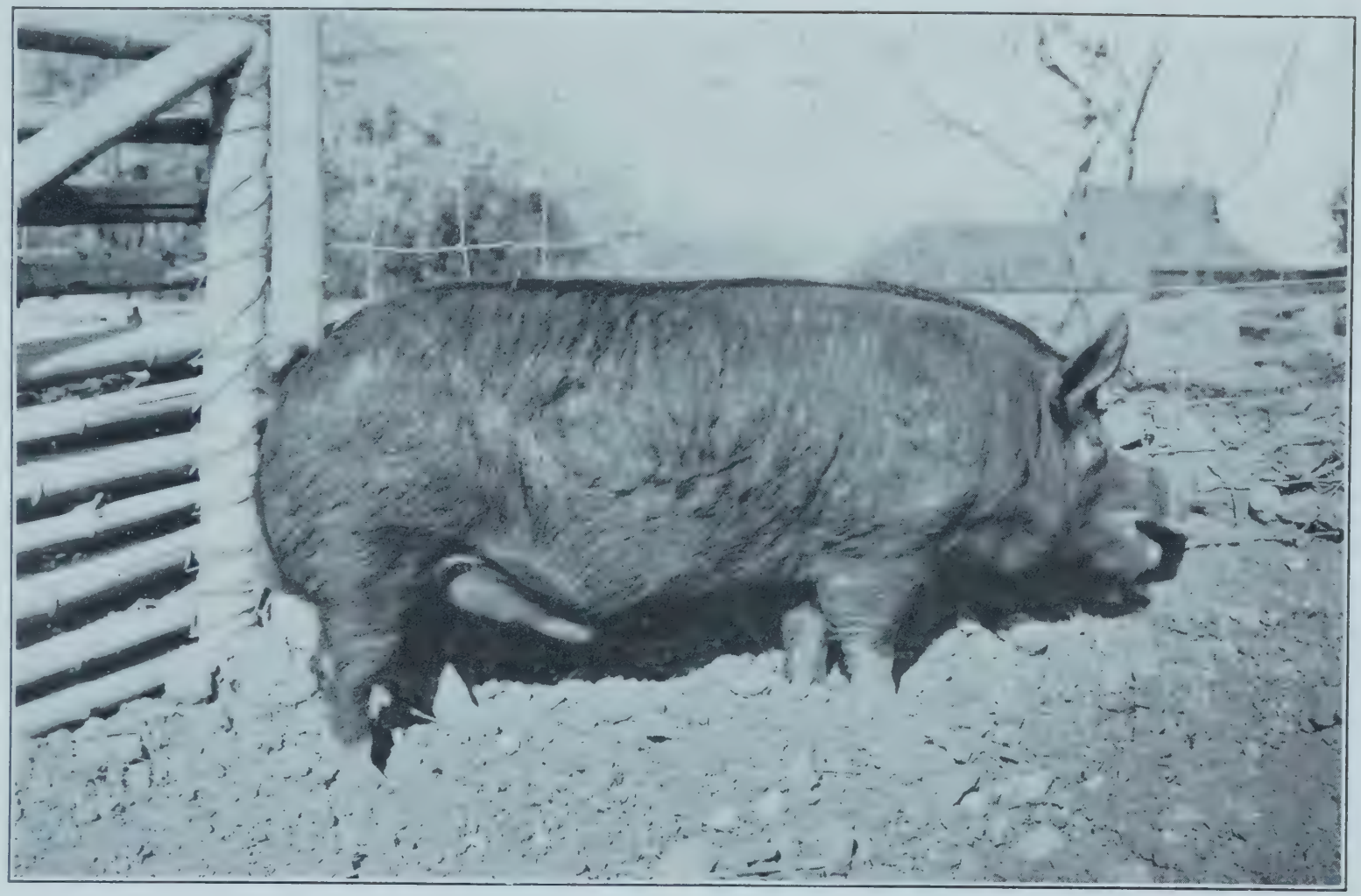
Forage crops.—At the Alabang stock farm, Guinea grass continues to be the main green forage crop. It is interesting to note that a field of this grass planted in July, 1910, is still producing heavily. Contrary to the common consensus of opinion, this grass has proved at this station to be a very fair pasture grass. The above-mentioned field was pastured very closely during the last two dry seasons with apparently no ill effects to the crop produced the following wet seasons. The principal objection to this forage as a pasture grass is its nonstooling character.

An experiment was carried on at this station to determine the best methods of planting Guinea grass. Two plots 2 meters wide and 300 meters long were selected, one being planted after the manner of palay seeding, the other in ordinary rows. The later gave by far the heavier yield. However, the portion of the field closely planted made a sufficient growth to indicate that this method could be safely used in planting for pasture.

Considerable sorghum was grown during the past year. The method of broadcasting proved quite successful during the wet



Good type of grade or "mestizo" stallion, Alabang stock farm.



Pure-bred Berkshire boar, type used in pure-bred and public-breeding work.

season; however, this method is not advocated for the dry season as cultivation is necessary at that time.

About 3 hectares of paspalum was planted out and it promises to become of great value as an improved pasture grass at this place. It was found, however, that the grass, although being very drought resistant, failed to make an appreciable growth during the dry season without irrigation. The grass proved palatable to all classes of stock.

Sudan grass (*Andropogon halepensis*), of which a small plot was grown, is a very slender-stemmed sorghum which promises to be a very valuable green fodder for horses. The yield is apparently about 12 tons per hectare, producing three cuttings per season.

The Rhodes grass (*Chloris gayana*) continues a successful hay grass. Three cuttings of the grass have been made during the past year and there is a sufficient supply of baled hay on hand for the needs of the station for at least one year. No hay has been purchased at this station since December, 1911.

Para (*Panicum barbinode*), although not as palatable to the stock or as heavy a producer as Guinea grass, proved very well adapted to low swampy areas where other improved grasses failed to grow.

Japanese sugar cane, a very slender-stemmed quick-growing cane with an immense amount of foliage, when grown in conjunction with stizolobium bean produced an immense tonnage of very fair green roughage. The cane was planted about the middle of February, 1913, and at the time of cutting averaged 1.6 meters in height. A point in favor of the stizolobium bean is the fact that weevils do not destroy the seed when harvested.

Silo.—The silo completed the early part of the past fiscal year has proved a very successful venture. This silo is built entirely of reënforced concrete, being 20 feet (6.20 meters) in height and 16 feet (5.07 meters) in diameter, with a capacity of approximately 110 tons.

The first two-thirds of this silo was filled with a mixture of sorghum and sugar cane, and the last third with sorghum mixed with cogon and aguiñgay grasses in the proportion of about two-thirds sorghum to one-third grass. The silage produced was of first quality, the animals eating it with relish. Formerly there was a shortage of feed supply at this station for work animals during the months of November, December, and January; the silo, however, has been found to entirely meet the needs at that season of the year.

TRINIDAD STOCK FARM.

The conditions at this farm have remained very satisfactory throughout the year. The cattle have been kept in the best of condition on the station pasturage, no grain being fed to any of the herd excepting the two pure-bred bulls.

The principal improvement consisted of the repair of about 3 kilometers of fence. No permanent improvements in the way of building were attempted.

The station superintendent has a very good general knowledge of veterinary practice and has frequently been called upon to attend to the ailments of animals of the vicinity. Seventeen native stallions and one bull were castrated during the year. The total amount of money received for subsistence of private animals was ₱557.21. Of this sum ₱309.16 was collected for pasturage alone.

The laborers used at this station during the period were for the most part Igorots, as these people have proved better adapted for handling live stock and for general work than other classes of labor available at this place.

PUBLIC BREEDING PROJECT.

The object of this project is the upgrading of the native live stock by offering free to the public the services of improved sires.

The system or plan of work pursued is the maintenance of stud animals for public use at (1) permanent provincial central stations, (2) temporary provincial stations, and (3) at the regular farm stations. Aside from these methods a few animals are loaned on memorandum receipt to various branches of the Government.

In connection with this public breeding work (aside from that carried on at the Bureau farms), the promiscuous loaning of sires was formerly extensively practiced. The results were so unsatisfactory that the plan is now followed in but few instances. It has been found that in order to obtain satisfactory results facilities for the proper care and handling of the animals must be provided and the work placed in charge of a competent superintendent. The results of the past few years show that the most satisfactory means yet adopted of supplying these requisites is through the central stations.

During the fiscal year 1912 the first two central stations were established at Virac and Bagamanoc, Catanduanes, and in October of the present year the Batangas station was completed.

At the two former stations the entire expense of maintenance is defrayed by the provincial government, while at Batangas the Bureau provides for the care and maintenance of the animals, the farm labor being supplied by the province.

The results accomplished at these stations have exceeded expectations, and the people are showing a keen interest in the work that is being carried on.

At Batangas and Virac the stations also provide a center for the conducting of the agricultural demonstration work.

Catanduanes.—The work of the year in the Island of Catanduanes has been productive of very good results. The stallions located at this place are credited with a total of 263 first and 169 return services, and 160 foals, by these sires, have been dropped during the year.

The Nellore bull No. 412 is allowed to run at large with the herds that pasture in the vicinity of Virac. It is difficult to keep an exact record of results in this connection, although 14 calves have been identified as his get during the season. These crosses are spoken of by Mr. Koert as being distinctly of the Indian type.

An effort is being made in this island to impress the people with the importance of castrating inferior male animals, and during the year the superintendent has performed 125 emasculations.

In connection with the swine breeding at this station the practice of having the sows brought to the boar for service did not prove satisfactory, owing principally to the fact that the owners were ignorant as to the proper time to present the animals. The system followed at present of allowing the boar to run at large in the various near-by barrios has been conducive of much better results.

The Arabian stallion "Pharaoh" died on March 16. On February 16 the station at Bagamanoc was removed to the former municipality of Payo, which place is more centrally located and has better facilities for the growing of forage and pasturage.

A trail from Virac to Viga is in the process of construction, upon completion of which it is recommended that a large stallion be sent to this station.

Batangas.—The fact that the three stallions, although located at the Batangas station since November 5 only, have had a total of 355 services is the most convincing evidence of the interest that the people of the province are taking in this work. In spite of this heavy service the stallions have been maintained

in the pink of condition, due to the efforts of the foreman who is directly in charge of stud animals at this station.

Temporary stations.—At the beginning of the year the stallions Hassan, Sakarra, and Highball were located at temporary stations in the Ilocos Provinces, in charge of a Bureau foreman. It became necessary on September 7, 1912, to transfer this foreman to Manila, at which time the stallions were loaned on memorandum receipt to the province, and placed in direct charge of native caretakers.

During the period that the foreman had charge of the work, very successful results were obtained, but soon after his transfer the number of services decreased rapidly and the stallion Sakarra was transferred to Manila on February 4, 1913.

Oriental Negros.—Since the beginning of the year the Arabian stallion Vedas, native stallion No. 185, and Indian bull No. 420 have rendered good service in the island of Siquijor, as has also the Arabian stallion Noureddin, located at Dumaguete since December 8, 1912.

The central-station plan, as previously stated, has proven by far the most efficient of all methods attempted in connection with the public breeding work. Although there are as yet but two of these stations, it is considered that the results achieved in the short time since their establishment are equal to those accomplished during the entire previous period from the miscellaneous loaning of stud animals.

HORSE PROJECT.

The object of this project is the production of superior horses for disposal to the public for breeding purposes, and for use of the Bureau in conducting the various lines of breeding work.

Alabang.—The work in this direction progressed most satisfactorily at Alabang during the first three quarters of the year, but with the fourth quarter occurred an outbreak of surra from the effects of which the horse-breeding work at this station received a most serious check. The total number of cases resulting from this outbreak was 24, the last case occurring on June 16. Of this number 5 deaths were reported previous to the end of the fiscal year. Every possible precaution has been taken to prevent the spread of the disease and it is not likely that more cases will appear.

A total number of 20 foals have been dropped at the station during the year, and a total number of 157 services credited to the station studs.

A sufficient amount of Rhodes-grass hay has been produced

on the farm to supply the entire needs of the station. During a portion of the year the brood mares and foals were pastured on paspalum grass, which appeared to be a palatable pasture of good sustenance.

La Carlota.—The horses at this station have been kept in very good condition throughout the year. All mares received a daily grain ration of about 3 kilos, and for a portion of the time green forage in the form of Guinea grass or cane tops, practically no hay being fed. A total number of 17 foals were dropped, 75 per cent of the mares foaling as against 40 per cent for the year previous.

The Arabian stallion No. 118 and native stallions L–53 and L–77 were at the head of the stud during the period.

CATTLE PROJECT.

The main object of this project is the production of improved breeding animals for disposal to the public.

The work under this project has been carried on at Alabang, La Carlota, and Trinidad, and the following classes or types were produced:

Alabang: Pure-bred Indian; Indian grades; Hereford grades.
La Carlota: Pure-bred Indian; Indian grades.
Trinidad: Galloway grades; Angus grades; Indian grades.

Alabang.—All cattle at this station were included in the three following herds with the stud sire as shown:

Herd.	*Sire.*
1. Pure-bred Nellore	Nellore, No. L–31
2. Chinese	Hereford, No. 313.
3. Native and grades	Hereford, No. 313. Indian, No. 398.

The pure-bred Nellore herd continues to thrive and during the past dry season, although the pasture was very sparce, no grain was fed to this herd and but very little cut forage. The condition of these animals at the end of the short pasture season is a very conclusive indication of the rustling qualities of this breed.

The Hereford grades from Chinese dams produced during the year were very promising calves, showing characteristics of the sire to a very marked degree; the only objection to these offspring was the slight wooly coat which makes them liable to tick infection.

Of all the mestizos or grade cattle produced at this station, the Nellore–Chinese and native crosses (offspring from Nellore sires out of Chinese and native dams) are the most satisfactory.

One objection to the Nellore breed is its extreme legginess and rangy body conformation. These grades, however, seem to be much blockier or beefy, more docile, earlier maturing, and apparently better rustlers. They are also much larger than the native or Chinese dams, and above all are immune or at least very highly resistant to rinderpest.

The total number of calves dropped at this station during the season was 32.

La Carlota.—At this station three herds are maintained, as follows: Pure-bred, Indian-Chinese, and grade or mestizo. Pure-bred Nellore bulls are used exclusively.

The pastures at La Carlota are very abundant and no trouble is ever experienced in maintaining the animals through the dry season. There were very few deaths from any cause among the cattle at this place during the year, both the pure-breds and grades keeping in the best of condition.

From data gathered at this station it was determined that pure-bred Indian heifers drop their first calf at approximately 36 months of age, Indian-mestizos at 30 months, and Chinese at 24.

A small herd of carabaos containing 12 cows and 1 bull is kept at this station. Eight calves are the get of this herd for the year.

The total number of calves dropped at this station during the season was 47.

Trinidad.—A Galloway grade herd of 28 cows and the Chinese herd numbering 18 aged cows, together with a large number of grade heifers, constitute the herds at the Trinidad stock farm.

All cattle at this place have done very well the past year, no grain or cut forage being fed excepting to the two stud bulls. The Galloway-Chinese grade herd was bred to the Nellore bull and the Chinese cows to the Angus bull.

For the first time in the history of the station the cattle have been kept practically free from ticks through frequent change of pasturage and the use of an arsenic dip.

The total number of calves dropped at this station during the season was 36.

SWINE PROJECT.

The raising of pure-bred Berkshire swine for disposal to the public for breeding purposes continues to be one of the most successful lines of breeding undertaken by the Bureau of Agriculture.

The features in which this phase of live-stock improvement excels some of the other lines of breeding are the comparatively small amount of capital necessary for the work, the short length of time requisite for the production of results, and the interest of the people in swine breeding.

The Berkshire breed has proved particularly well adapted for the upgrading of the native swine; the first cross shows a preponderance of the pure-bred characteristics and appears practically as well adapted to local conditions as the native stock.

The Alabang stock farm is the only station at which any considerable amount of work is attempted in this direction. The pigs at this station have, apparently, entirely recovered from the kidney-worm disease, which was found present in a number of individuals during the fiscal year 1912. Only three deaths have occured from this cause during the entire present year.

The pigs at the Lamao station at the beginning of the year were transferred in December, 1912, a part of the number being sold at Singalong and the remainder sent to Alabang for breeding purposes.

The demand for pure-bred pigs has been much greater than the Bureau has been able to supply. To meet these requests the breeding herd at Alabang has been considerably increased during the year, and an order has been placed in the United States for the purchase of 32 additional head of stud stock.

GOAT PROJECT.

The animals assigned to this project are confined to a small Spanish grade herd at La Carlota and a Maltese grade herd at Alabang, numbering a total of 119 head. These herds are the resultant crosses from the pure-bred Spanish and Maltese goats, imported by the Bureau a few years ago. With the death of two pure-bred Spanish animals at La Carlota the first part of the year, the entire number of pure breds from this importation had succumbed to a parasitic disease, the nature of which has never been determined.

The present grade herd is apparently free from this disease, and the percentage of increase for the year has been very high, especially at Alabang. Although these grades have subsisted well on the native pastures and are in good condition physically, they are very small in size; in fact, some of them are inferior in this respect to many pure-bred native goats. These animals, however, show many of the milking characteristics of the Maltese and Spanish pure breds, and they should form a very good

foundation stock for the production of high-grade types by crossing with pure-bred sires of some good milk breed. To this end a requisition has been placed for five Swiss goats to be secured in the United States, and from the Alabang herd about 30 of the best females will be selected and mated with these pure-bred males.

SHEEP PROJECT.

Very little has yet been attempted by the Bureau in the line of sheep raising.

During the year this work has been confined to Alabang, where a small herd of imported Merinos have been maintained.

These sheep have been kept free from disease, not even a case of foot-rot appearing during the wet season. The fleece of the lambs born at the station during 1912 and that of the aged animals appears to be of good quality, and a good clip was taken from them in April of this year. On the other hand, no lambs from the 7 females of the herd have been dropped since April, 1912.

VETERINARY DIVISION.

PERSONNEL.

On July 1, 1912, there were on duty 41 veterinarians, 64 American live-stock inspectors, 223 Filipino live-stock inspectors, 1 pathologist (veterinarian), and 1 veterinary entomologist. On June 30, 1913, there were on duty 37 veterinarians (1 loaned to the Veterinary College and 7 on leave), 47 American live-stock inspectors, 237 Filipino live-stock inspectors, 1 pathologist (veterinarian), and 1 veterinary entomologist. This shows a decrease of 4 veterinarians and 17 American live-stock inspectors with an increase of 14 Filipino inspectors.

ANIMAL-DISEASE ERADICATION.

RINDERPEST.

At the beginning of the fiscal year rinderpest was prevalent both in the Visayas and on the island of Luzon. Eleven provinces with 35 municipalities were known to be harboring infection. Outside of Luzon, infection was found in the Provinces of Surigao, Capiz, and Iloilo. On Luzon the disease was confined to the Provinces of Bulacan, Isabela, Laguna, Mountain, Pampanga, Pangasinan, Rizal, and Zambales.

Of the provinces infected at the beginning of the fiscal year, Isabela, Pampanga, Pangasinan, and Zambales were known to

be infected on June 30, 1913; Bulacan, Capiz, Iloilo, Laguna, Mountain, Rizal, and Surigao were cleaned up during the year, and no rinderpest infection had been verified in any of these provinces up to the close of the year.

Provinces not known to be infected at the beginning of the fiscal year, which became infected during the year and were regarded as free from the disease on June 30, 1913, are Agusan, Ambos Camarines, Antique, Bohol, Cavite, Leyte, and Tarlac.

Provinces not harboring infection on July 1, 1912, and which were known to be infected June 30, 1913, are Cagayan, Ilocos Norte, Ilocos Sur, and La Union.

The largest number of provinces considered as infected at any one time during the year was 12, recorded during the week ended November 11, 1912. The smallest number infected during the year occurred during the week ended May 14, 1913, only 7 provinces being infected at that time.

The smallest number of municipalities showing infection at any one time during the year was 18, which occurred during the week ended October 28, while the largest number, 35, occurred during the week ended July 1, 1912.

At the end of the fiscal year June 30, 1913, but 8 provinces, with 24 municipalities, are known to be infected, showing a gain of 3 provinces and 11 municipalities during the year.

Iloilo, Capiz, Antique.—The large force of Bureau employees which at the beginning of the fiscal year was combating the serious outbreak of rinderpest in the Provinces of Iloilo, Capiz, and Antique, on the island of Panay, succeeded in cleaning up the last infected municipality during the week ended January 6, 1913. During the campaign on this island the Philippine Scouts very ably assisted in the quarantining of infected municipalities. The infection in Iloilo and Capiz was widespread. At one time in the Province of Iloilo eight municipalities showed infection and at another time, in Capiz, seven municipalities were known to be infected. Had it not been for the hearty coöperation of the provincial and municipal officials, as well as the spirit of coöperation shown by the people themselves, it would not have been possible to have cleaned up this outbreak in such a comparatively short time. The Philippine Railway Company, operating in the Provinces of Iloilo and Capiz, assisted the Bureau very materially by granting free transportation to Bureau employees as well as carrying, free of charge, freight and supplies used in connection with the campaign.

Leyte.—During the week ended July 29 infection was verified

in two municipalities in Leyte Province, and on August 4 four municipalities were infected. However, by September 30, 1912, the disease was eradicated. The Philippine Constabulary, on request, very promptly furnished 50 enlisted men for duty in the infected area. This force continued on duty until relieved by two companies of Philippine Scouts. As was the case on the island of Panay, the coöperation on the part of the provincial and municipal officials and the people in general in the infected municipalities of Leyte greatly assisted in cleaning up the infection.

Pampanga.—As the fiscal year closes, Pampanga Province presents the same difficult problem in the way of eradicating rinderpest that it did on July 1, 1912. There were on June 30, 1913, eleven municipalities in this province showing infection, while on July 1, 1912, but seven municipalities in Pampanga were known to be infected.

Bulacan.—During the week ended July 8, 1912, the last infected municipality in Bulacan Province was regarded as free from rinderpest. No more infection was reported from this province during the fiscal year. However, during the last week of June, 1913, several suspected cases of rinderpest were reported in the municipality of Hagonoy.

Ambos Camarines.—During the week ended January 13, 1913, an unknown disease, which caused the death of several cattle and carabaos in the Lagonoy district, Ambos Camarines Province, was reported. A thorough investigation of this outbreak was made and it was found to be rinderpest. A force of inspectors was employed and the veterinarian in charge instituted a rigid campaign against the disease, placing a close quarantine on all infected districts. On request, the Philippine Constabulary furnished enlisted men to be used as quarantine guards and the service rendered by these guards was very efficient. During the week ended March 14, 1913, the infection was considered as having been cleaned up and all quarantines were raised.

Agusan.—During the week ended March 14, 1913, rinderpest infection was reported in the Province of Agusan. The provincial officials, assisted by the Constabulary, took prompt action and placed effective quarantines in the infected districts, and the disease apparently did not spread outside of the limits of one municipality. On receipt of information that rinderpest existed in this province a veterinarian with several inspectors was sent to take charge. Under date of May 5, 1913, the province was reported as being clean.

Bohol.—Infection appeared in the Province of Bohol during the week ended November 18, 1912. A veterinarian with a force of inspectors was sent to the province and under date of January 6, 1913, reported no more disease. However, under date of March 14, reinfection appeared and on request, the Honorable the Secretary of Public Instruction issued an order placing a quarantine on the province. The provincial and municipal officials assisted the veterinarian in charge in every way possible and on May 12 the infection had been eradicated and as the fiscal year closes it has not reappeared. It is not desired, however, to raise the quarantine from the province until it is fully determined that the infection will not recur.

Cagayan.—Under date of February 3, 1913, rinderpest infection was reported in the Province of Cagayan. A veterinarian was sent to this province for the purpose of investigating to what extent the infection had spread. He made request for a force of insular inspectors, which it was not possible to furnish. The provincial officials also reported that the condition of provincial finances would not permit the employment of provincial inspectors for this work. At the present time there is on duty in Cagayan one veterinarian with one Filipino inspector. On June 30 there were two municipalities in Cagayan showing rinderpest infection.

Cavite.—During the month of November, 1912, infection appeared in this province. The provincial governor, who has full charge of the eradication of animal diseases in that province, took immediate steps to place quarantine on the infected municipalities and since December 16 no cases have been reported.

Ilocos Norte.—On November 11, 1912, the existence of rinderpest infection in this province was verified. As soon as possible thereafter a veterinarian was sent to Laoag to take charge of the work of combating the disease. There were no Bureau live-stock inspectors available to assist him. The provincial officials, however, were requested to furnish provincial live-stock inspectors and they authorized the employment of ten men. During the month of February, 1913, there were five municipalities in Ilocos Norte showing infection, but on June 30 but two municipalities were known to be infected. On account of the lack of properly trained inspectors it has not been possible to enforce the necessary quarantine measures to insure the cleaning up of the infection. Within a few months the rinderpest quarantine forces now working in the Province of Ilocos Sur will proceed northward into the Province of Ilocos Norte, when more rigid quarantine measures will be enforced.

Ilocos Sur.—During the month of November, 1912, rinderpest was reported in this province. In December a veterinarian with a large force of inspectors and Philippine Scouts was sent into Ilocos Sur and the diagnosis of the disease was verified. In January, 1913, no more infection having been discovered, the province was regarded as free. A thorough inspection of all municipalities in the province was inaugurated and during April new infection was discovered. The veterinarian who had charge of the work in La Union Province was relieved from duty there and, with the greater part of the forces which were working with him, was ordered to Ilocos Sur. As the fiscal year closes only one municipality in Ilocos Sur is known to harbor rinderpest infection. The provincial officials in this province have very heartily coöperated with the Bureau employees.

La Union.—In La Union Province rinderpest infection has existed in a greater or less degree since the early part of September, 1912, up to and including the close of the fiscal year. During the period from April 11 until May 26 this province was considered as free from infection. During October the rinderpest quarantine forces were operating in this province along the Pangasinan–La Union fence. They made a thorough inspection and quarantine of every municipality and barrio northward to the boundary line of Ilocos Sur. All rinderpest infection existing at that time was located and cleaned up. During the week ended May 26, infection appeared in the municipality of Rosario and is supposed to have been brought in from the Province of Pangasinan along the road to Camp One. Half a company of Philippine Constabulary and later a company of Philippine Scouts were made available for quarantine duty with the veterinarians and live-stock inspectors. As the year closes a very careful inspection and quarantine is being instituted in this municipality and surrounding barrios.

The quarantine fence between Camp One and Rabon, separating the Provinces of La Union and Pangasinan, has been very useful in preventing the free movement of animals between those two provinces. Two American and 12 Filipino inspectors continually patrol this fence and no person can move his carabaos or cattle past this fence without securing the authority of the veterinarian in charge.

Amburayan Subprovince.—During the week ended November 11, 1912, rinderpest infection was verified in Amburayan, a subprovince of the Mountain Province, and a veterinarian and a force of inspectors instituted a thorough inspection and quar-

antine. On March 1 this subprovince was declared free from rinderpest and remained so to the end of the fiscal year.

Pangasinan.—Pangasinan Province has harbored rinderpest infection during the entire fiscal year. On two occasions, once during the week ended September 2, 1912, and the other during the week ended June 23, 1913, this province was reported as free from disease. The week following in each instance showed that infection still existed. As the year closes two municipalities are known to be infected.

Rizal.—At the beginning of the fiscal year Rizal Province had a great deal of infection. During October and November the rinderpest quarantine forces made a very careful inspection of the different municipalities in this province. On their withdrawal from the province a small force was left to take care of the one municipality which remained infected. On February 10, 1913, this province was declared free from infection and has remained so to the end of the fiscal year.

Surigao.—At the beginning of the year one municipality in Surigao Province was known to be infected. Through the efforts of one American inspector, who succeeded in obtaining the hearty coöperation of the municipal and provincial officials, the province was declared clean under date of July 22, 1912. No known infection existed in the province at the close of the year.

Zambales.—Zambales Province has harbored infection during the entire fiscal year with the exception of the period from December 9, 1912, to January 13, 1913, inclusive. During October the rinderpest quarantine forces entered the province at the southern end and worked northward. Very little infection was found in the southern part of the province and in a short time it was cleaned up. After the forces moved to the northern part of the province infection was found in the municipality of Palauig. The disease spread rapidly and during the latter part of April and the beginning of May four municipalities were known to be infected. As the year closes only two municipalities are known to be infected.

Quarantines.—During the year the Provinces of Capiz, Leyte, Ilocos Norte, Ilocos Sur, Antique, Zambales, and Bohol were quarantined by order of the Honorable the Secretary of Public Instruction. The subprovince of Amburayan was quarantined by order of the Director of Agriculture. Orders previously issued, placing quarantine on the Provinces of Cagayan, Isabela, Pangasinan, Tarlac, Pampanga, La Union, Laguna, and Iloilo

have been revoked and new orders issued. The Provinces of Rizal, Laguna, Nueva Ecija, Bulacan, and Leyte have been released from quarantine. Authority has been requested to have the quarantines at present existing in the Provinces of Iloilo, Capiz, and Antique removed.

Cases and deaths.—During the year the field force has reported 4,731 cases of rinderpest with 2,787 deaths. This shows an increase of 419 cases, but a decrease of 60 deaths, when compared with the same data for last year. Seventy-two per cent of the new cases and 70 per cent of the deaths reported occurred in three provinces, namely, Pampanga, 1,785 new cases and 1,335 deaths; Zambales, 1,212 cases and 449 deaths; La Union, 438 cases and 184 deaths. The remaining 1,296 cases and 819 deaths were divided among the 19 other provinces reporting infection during the year. The distribution of these cases and deaths by quarters is shown in Table No. 1 below.

TABLE No. 1.—*New cases and deaths per week.*

	New cases.	Deaths.
First quarter	606	390
Second quarter	689	357
Third quarter	1,790	1,059
Fourth quarter	1,646	981
Total	4,731	2,787

The known amount of rinderpest infection at the beginning and at the end of the fiscal year and the number of political divisions involved are shown in Table No. 2 following:

TABLE No. 2.—*Rinderpest statistics, beginning and end of fiscal year.*

Week ended—	New cases per week.[a]	Deaths per week.[a]	Provinces infected.	Municipalities infected.	Barrios infected.
June 29, 1912	23	19	11	34	69
June 28, 1913	76	54	8	23	71

[a] Cattle and carabao.

The distribution and amount of rinderpest found during the last eight days of the fiscal year is shown in Table No. 3. Under the heading "suspects" are included those animals in which diagnosis had not been confirmed and which were under observation. "New cases" include all rinderpest cases placed in the corrals during the period. "Convalescents" include all that have been in the corral over eight days.

TABLE No. 3.—*Rinderpest during last eight days of fiscal year.*

Provinces.	Suspects.		New cases.		Convalescents.		Deaths.	
	Cattle.	Carabao.	Cattle.	Carabao.	Cattle.	Carabao.	Cattle.	Carabao.
Cagayan				5		6		10
Ilocos Norte		14		7				1
Ilocos Sur	1							
Isabela								
La Union		20		8		38		4
Pampanga		2		30		39		27
Pangasinan			2	5	2		2	1
Zambales		7		7	41	68	1	3
Total	1	43	2	62	43	151	3	46

Under Table No. 7 (appendix) is shown the distribution of rinderpest cases and deaths.

FOOT-AND-MOUTH DISEASE.

This disease was found among some cattle brought into Manila from Indo-China; also a very severe outbreak occurred in the Province of Capiz. There were 576 cases among the Indo-China animals with 9 deaths. In Manila the infection did not spread beyond the corrals in which the animals were kept.

There were registered in the Capiz outbreak 480 carabao and 14 cattle as infected, with only 1 death. This province was reported free during April, but as the fiscal year closed notice was received of a reinfected municipality. (See Table No. 7, appendix.)

SURRA.

This infection has been reported in eight different provinces since July 1, 1912, but only a small number of cases and deaths have been registered. Requests have been received at different times from infected districts for the services of veterinarians to combat this disease, but owing to the rinderpest campaign being waged in the different provinces it has been impossible to assign any veterinarian permanently to this work. In one or two instances a veterinarian was sent to a badly infected locality for the purpose of explaining the procedure to be followed to prevent the spread of the infection. (See Table No. 8, appendix.)

GLANDERS.

A few cases and deaths have been registered in four provinces and in the city of Manila. This disease is known to be very prevalent in the island of Catanduanes, Albay Province, but there are no statistics to show to what extent it exists. At the

request of the local officials in Albay Province a veterinarian was sent to Catanduanes Island for the purpose of inaugurating a campaign which would insure the final eradication of the disease. On account of the sickness of this veterinarian it has been necessary to suspend operations for the time being. (See Table No. 8, appendix.)

CONTAGIOUS PLEUROPNEUMONIA.

This disease is only found among cattle imported from Australia into the barrio of Sisiman, Bataan Province, to be slaughtered for beef purposes. In order to prevent the possibility of spreading the infection from this place to other parts of the Philippine Islands, an order was recently issued placing this barrio in quarantine.

MISCELLANEOUS DISEASES.

Epizoötic lymphangitis, anthrax, and hemorrhagic septicemia have been found in such a limited degree throughout the Islands during the year that special reports on these diseases are not warranted. (See Table No. 9, appendix.)

PHILIPPINE SCOUTS AND CONSTABULARY ON DUTY JUNE 30, 1913.

The following table shows the number of Philippine Scouts and Philippine Constabulary on duty with the Bureau of Agriculture at the close of the fiscal year.

	Officers.	Enlisted.		Total.	Provinces in which located.
		Noncommissioned.	Private.		
Philippine Scouts	25	149	727	901	Ilocos Sur, La Union, Pampanga, Pangasinan, and Zambales.
Philippine Constabulary	2	13	75	90	Nueva Vizcaya and Ilocos Sur.

The work of the Philippine Scouts continued throughout the present year to be of the same high order of efficiency as during the fiscal year ended June 30, 1912. Their duties, although of a very arduous nature, have been performed in an exceedingly creditable manner. Without the assistance of this organization it would be an exceedingly difficult problem to establish successful rinderpest quarantines.

The Philippine Constabulary have always been ready to cooperate with the veterinarians in every way possible. In several



Simultaneous inoculation at Iloilo, 1912. Inspector taking notes.



Isolation of animals in a barrio infected with rinderpest.



Corral for the isolation of animals infected with rinderpest.

instances whole companies have been placed in a newly infected district, which have held the quarantine lines until the Philippine Scouts could be made available to relieve them that they might return to their regular duties. Too much cannot be said as to the efficient service rendered by the officers and men of this organization when detailed on quarantine duty.

IMPORTATION FROM FOREIGN PORTS.

Only two shipments of cattle and carabaos have been imported into the Philippine Islands during the year from Indo-China. For other importations see Table No. 2 (appendix).

General Order No. 30, dated June 6, 1913, provides for ninety days' quarantine on lighters, cascoes, or other suitable vessels of all cattle, carabaos, sheep, goats, or swine imported from any foreign port considered and declared by the Director of Agriculture to be infected with a dangerous communicable animal disease. Animals received from foreign ports which are not covered by regulations may be landed in the Philippine Islands and subjected to a quarantine of thirty days. If brought from a foreign port for which no regulations have been promulgated, and accompanied by satisfactory proof to the effect that the country of origin has no dangerous communicable animal diseases and that they were not exposed to such diseases en route, animals imported into the Philippine Islands may be subjected to only a ten days' quarantine, provided no disease occurred among them while undergoing quarantine.

QUARANTINE STATIONS.

PANDACAN QUARANTINE STATION.

During the year there were 876 cattle and 287 carabaos received in this station, which, with the 207 cattle and 31 carabaos on hand at the beginning of the year, makes a total of 1,401.

One thousand one hundred and sixty of these animals were subjected to simultaneous inoculation, the results of which are shown in the following table:

Received.	Died before injection.	Date of injection (1912).	Serum per head.	Reactions.		Released.	Loss after injection.	
				Number.	Per cent.		Number.	Per cent.
			c. c.					
315	----------	Sept. 20	350	67	21	315	----------	----------
561	----------	Oct. 23	150	91	16	551	10	1.8
140	----------	Sept. 20	350	15	10	140	----------	----------
144	4	Dec. 20	300	37	26	136	4	2.8

Simultaneous inoculation.—In the report of this Bureau for the previous fiscal year statement was made to the effect that "the results do not encourage the belief that simultaneous inoculation of imported animals would be practicable." The greater part of the animals subjected to this treatment during the preceding fiscal year were at the time infected with rinderpest, which undoubtedly accounted for the large percentage of deaths. It would appear, however, from the results obtained during the present year that when healthy animals are given simultaneous inoculation, which was the case of those as shown in the foregoing table, that a very small percentage of deaths occur. (See Table No. 10, appendix.)

ILOILO QUARANTINE STATION.

This station was not used during the year for foreign cattle and carabaos. A veterinarian was on duty in Iloilo during the entire year for the purpose of inspecting animals entering and leaving the port from and to interisland points. This precautionary measure was deemed necessary in order to protect the Provinces of Iloilo and Capiz from possible infection.

SISIMAN MATADERO.

During the year 9,697 Australian cattle were brought into this station, and 9,646 passed for food purposes. Fifty-one carcasses and 3,666 parts were condemned. The total revenue derived was ₱68,853.52. (For causes of condemnation of carcasses and parts see Table No. 11, appendix.) Only one importer has, during the year, availed himself of the privileges of this matadero.

SAN LAZARO STATION.

During the year this station was used as a clinic by the College of Veterinary Science, University of the Philippines. It has also continued to serve as a station for the quarantining of horses infected with surra and glanders.

INTERISLAND SHIPMENTS.

There have been brought into Manila from interisland ports during the year 4,833 cattle and 1,171 carabaos. Most of these were animals from the Batanes Islands, although several shipments were brought from the Provinces of Ilocos Norte and Ilocos Sur. When they are brought in from these last two named provinces they are required to be quarantined for fifteen days before leaving those provinces. For the Province of Ilocos Norte,

Currimao, and for Ilocos Sur Province, Salomague or Vigan, are the ports which were designated as those from which animals could be shipped. In all cases animals shipped from these ports had to be brought to Manila, and on arrival here were subjected to another ten days' quarantine before permits were issued for shipment to their destination. This interisland regulation is still in effect as the year closes. (See Table No. 2, appendix.)

INSPECTIONS.

Inspections for which fees were charged.—There were inspected on arrival in the city of Manila 73,982 animals of all kinds, for which fees amounting to ₱9,686.90 were charged and collected. Of these animals 63,812 were swine. (See Tables Nos. 3 and 4, appendix.)

Post-mortem inspections in Manila matadero.—There were 69,718 animals of all kinds inspected at the Manila matadero during the year, 917 being condemned and 68,801 being passed for food. (For further information see Tables Nos. 5 and 6, appendix.)

RESEARCH WORK.

Research work has continued during the past year being directed primarily toward the investigation of various problems associated with surra and rinderpest.

The veterinary entomologist has been conducting a series of experiments directed toward definitely determining the species of fly responsible for the dissemination of surra. Representatives of several genera of common horseflies were tested and eliminated as possible factors, but recently *Tabanus striatus* has been incriminated. The whole attention of the employees conducting the work may now be turned to the study of breeding habits, etc., with reference to devising more effective preventive measures against surra.

The veterinary pathologist devotes his attention largely to the pathology of rinderpest and clinical manifestations of the disease. He has underway a piece of work involving a very extensive study of the gross and microscopic lesions of rinderpest, a work which merges into the study of the problem of the etiology of rinderpest.

The study of the peculiarities of the transmission of rinderpest and viability of the infective agent under various conditions has yielded results of far-reaching value in guiding the quarantine measures enforced in the campaign in progress.

The completed research work is indicated by the following titles of papers published during the year, or which have been prepared and are awaiting publication:

Symptoms and Lesions Presented by Cattle and Carabaos Suffering from Rinderpest in the Philippine Islands. By William Hutchins Boynton, Philippine Agricultural Review, Vol. V, No. 12, 1912.

Collected Notes on the Insect Transmission of Surra in Carabaos. By M. Bruin Mitzmain, Philippine Agricultural Review, Vol. V, No. 12, 1912.

The Surra-conveying Fly of the Philippines and Some Factors Concerned in Control Measures. By M. Bruin Mitzmain, Philippine Agricultural Review, Vol. VI, No. 8, 1913.

Observations on the Clinical Diagnosis of Glanders. By C. H. Schultz, Philippine Agricultural Review, Vol. VI, No. 8, 1913.

Kidney-worm Infestation of Swine. By Wiliam Hutchins Boynton, Philippine Agricultural Review, Vol. VI, No. 8, 1913.

A Note upon Strangles in the Philippine Islands. By William Hutchins Boynton, Philippine Agricultural Review, Vol. VI, No. 8, 1913.

The Role of *Stomoxys Calcitrans* in the Transmission of *Trypanosoma Evansi.* By M. Bruin Mitzmain, Bulletin No. 24, Bureau of Agriculture, and Philippine Journal of Science, Sec. B, Medical Sciences, Vol. VII, No. 6, 1912.

A Note upon Strangles in Philippine Islands. By William Hutchins Boyton, Philippine Journal of Science, Sec. B, Medical Sciences, Vol. VII, No. 3, 1913.

The Biology of *Tabanus Striatus Fabricus.* The Horsefly of the Philippines. By M. Bruin Mitzmain, Philippine Journal of Science, Sec. B, Medical Sciences, Vol. VIII, No. 3, 1913.

A Note on the Mechanical Transmission of Surra by *Tabanus Striatus Fabricus.* By M. Bruin Mitzmain, Philippine Journal of Science, Sec. B, Medical Sciences, Vol. VIII, No. 3, 1913.

Kidney-worm Infestation of Swine in the Philippine Islands, with Special Reference to the Pathological Changes. By William Hutchins Boynton, Philippine Journal of Science, Sec. B, Medical Sciences, Vol. VIII, No. 5, 1913.

The Transmission of Rinderpest. By Archibald R. Ward, Frederick William Wood, and William Hutchins Boynton, Philippine Journal of Science, Sec. B, Medical Sciences, Vol. VIII, 1913.

An Atypical Case of Rinderpest in a Carabao. By William Hutchins Boynton, Philippine Journal of Science, Sec. B, Medical Sciences, Vol. VIII, 1913.

Notes on the Bionomics of *Lyperosia Minuta* and the Relations of this Fly to Experimental Surra. By M. Bruin Mitzmain, Philippine Journal of Science, Vol. VIII, 1913.

DIVISION OF AGRONOMY.

The work of this division includes investigations with rice, maize, sugar cane, grasses and forage crops, and cover crops.

Investigations with rice and maize have been confined to variety tests, seed selection, tests of cultural methods, and tests

of fertilizers. Much of the work with grasses and forage crops has been confined to finding a grass satisfactory for haymaking, but tests for adaptability and yields are also carried on with a large number of crops that appear to be suitable for this climate. The work with cover crops has been confined to testing the various cover crops for amount of green matter produced per hectare, and plowing them under in order to note the effect on subsequent crops.

Rice.—The poorer varieties have been weeded out in the variety tests of rice which have been carried on for the past five years until now the Bureau has only 128 varieties of lowland rice of which 90 have given an average yield of more than 2,000 kilos per hectare as an average for two or more years. Twelve of the better varieties have been distributed to planters for the purpose of making tests under field conditions.

Two hundred and forty-seven varieties of upland rice, previously tested at Lamao, have been planted at La Carlota, Occidental Negros.

In order to clean all varieties of any red rice which might have become mixed in with the white, all the seed to be planted was passed over a plate of glass which had light reflected from below. By this method any colored grains could be easily detected and removed.

A preliminary test of thickness of planting seems to indicate that the yield may be increased by transplanting a larger number of plants on 1 hectare than has been the custom heretofore.

A second test of long-season varieties, grown during the dry season, from January until June, has demonstrated that those varieties requiring over one hundred fifty days to mature will not develop properly if grown at this season of the year. They seem to die down before sending up flower stalks.

Two fertilizers tests with rice have been conducted during the year, one with lime as the principal factor, and one in which an attempt was made to discover if the soil was deficient in any of the three principal elements—nitrogen, phosphoric acid, and potash. The results were nonconclusive. As this was the second year this work has been carried on with similar results both times, it would seem that fertilizers are not profitable when used on rice.

Maize.—Many tests have been made during the year with foreign varieties of maize. No variety has been found, however, which promises to be superior to the native varieties, when all things are taken into consideration. Some of the softer dent

varieties will give heavier yields than the native kinds, but these soft varieties are quickly destroyed by weevils, hence they must be consumed at once or the grain is rendered worthless by the weevils. The "Moro," which is white, and the native yellow, commonly called "Laguna yellow," are perhaps our best varieties for average conditions.

A test of fertilizers with maize seems to indicate that it would not be profitable to apply chemical fertilizers to the maize crop under ordinary conditions.

In order to secure data upon the composition of the various kinds of maize being grown in the Islands, a collection was made of the different varieties and sent to the Bureau of Science for analysis. The following table gives the composition of seven varieties of Philippine maize:

Table showing chemical composition; analyses by Bureau of Science.

Name.	Moisture.	Fat.	Carbohydrates.	Protein.	Ash.	Crude fiber.	Total.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Laguna yellow	11.34	4.96	72.91	7.96	1.20	1.63	100
Mexican June	11.46	4.94	71.52	9.28	1.46	1.34	100
Moro	11.60	4.81	69.76	10.50	1.54	1.79	100
Cebu purple	11.00	4.38	71.61	10.17	1.03	1.81	100
Cebu white, small	11.50	4.42	70.94	9.45	1.73	1.96	100
Iloilo yellow	11.69	4.89	73.18	7.88	1.33	1.03	100
Iloilo white	11.32	5.96	70.55	9.10	1.53	1.54	100

Sugar cane.—The six Hawaiian varieties of sugar cane growing at Alabang were analyzed at intervals, after all the varieties had arrowed, to determine the best date for harvesting. The following table gives the data obtained:

Analyses of sugar cane.

Cane No.	Polarization.				Purity.			
	Jan. 20.	Feb. 12.	Feb. 24.	Mar. 5.	Jan. 20.	Feb. 12.	Feb. 24.	Mar. 5.
H-16	10.87	12.9	14.7	16.9	79.9	83.4	86.0	86.0
H-20	15.95	16.6	17.3	19.3	87.7	87.6	87.5	91.3
H-27	14.10	15.8	13.1	15.5	84.3	86.3	80.0	85.2
H-69	13.85	15.7	14.5	13.8	63.9	86.4	84.9	83.7
H-227	14.10	15.7	15.9	16.6	84.8	86.7	85.1	88.0
H-309	11.40	14.2	14.6	16.1	81.3	80.9	84.5	87.4

These varieties were planted on rather stiff clay underlaid with limestone rock. The average yield of cane was about 110 metric tons of stripped cane per hectare. A similar test was made of the same varieties growing at La Carlota, Occidental Negros, with about the same results as given above.

The larger Hawaiian varieties are becoming more popular now that a number of centrals are in operation which are able to handle these large canes as well as the smaller ones.

Grasses and forage crops.—Work with grasses has been rather discouraging owing to the fact that much of the seed purchased for planting new seed beds failed to germinate. As a result of this we have failed to secure a large area of Rhodes grass for haymaking. The hay that has been made from the area planted last year has proved satisfactory in every way.

Sudan grass grows entirely too large for haymaking and if sown thickly the blades are destroyed by rust. As a green forage crop it does not compare with some of the sorghums or Guinea grass.

Nonsaccharine sorghums do fairly well when planted during the dry season. Black hull white kafir gave a yield of 40,228 kilos of green forage per hectare; dwarf milo gave a yield of 35,743 kilos of green fodder per hectare; red kafir gave a yield of 34,791 kilos of green fodder per hectare; and pink kafir gave a yield of 38,189 kilos of green fodder per hectare. When these varieties were planted so that the greater part of their growth was made in the rainy season, the yield of green fodder was only about one-third of the amounts recorded above; while the yield of seed during the dry season was reduced more or less by the ravages of insects (principally plant lice) and plant diseases, it was practically nil during the rainy season.

LA CARLOTA EXPERIMENT STATION.

The production of sugar on a commercial scale has been discontinued at La Carlota. The principal operations of this station for the past year have been with fiber crops (reported under the fiber division) and experimental work with different varieties of sugar cane.

Sugar-cane experiment No. 1.—The plats containing the 6 varieties of Hawaiian canes planted in the nursery in front of the dwelling house in July, 1911, with seed cuttings from Alabang, having become mixed, they were plowed up and the stools destroyed. From these plats a neighboring planter was given all the points of H–27 and H–309.

Sugar-cane experiment No. 2.—This plat used for the comparison of varieties was planted January 25, 1912, in the northeast corner of the experiment cane field. It consisted of the 13 varieties named below, three rows of each, 1.37 meters apart and 15.2 meters long, 40 points being placed in each row and

one row left vacant between the varieties. The seed points of the "H" varieties were received from Alabang, "Formosa" from Hacienda Esperanza, and the balance was grown at this station.

H–27, H–309, H–227, H–16, H–20, H–69, Negros, Striped Louisiana, Formosa, Lahaina, Yellow Caledonia, Rose Bamboo, and Inalmon were grown on these plats. Canes from these plats were analyzed in the Iloilo sugar laboratory. These plats are now ratooning and will be known as "continuation of sugar-cane experiment No. 2."

The determination of the yield of ratoon cane from some of these plats is precluded for the reason that the storm of October, 1912, left a large part of the cane on the ground. This cane took root and formed new stools between the rows. To prevent the possibility of the varieties becoming mixed, it was necessary to destroy a portion of some of the plats.

Sugar-cane experiment No. 3.—Fertilizer test occupies the southern two-thirds of the experimental cane field. This experiment consists of 30 one-fortieth hectare plats, planted in duplicate with native Negros cane and fertilized. The planting was done December 10–19, 1912. Each plat is 10 by 25 meters and contains seven rows of cane 1.43 meters apart. Each row contains 60 points. This is at the rate of 16,800 points per hectare.

Sugar-cane experiment No. 4.—This plat used for comparison of varieties is located in the nursery in front of the dwelling house. All seed is grown at this station except "Tigbao Mestiza," which was found at Hacienda Najalin. It consists of one plat containing one line of each of 14 varieties. The rows are 1.37 meters apart and 16.46 meters long. Forty selected points were planted in each line February 7, 1913. This is at the rate of 17,740 per hectare. This plat was located in the nursery to better protect it from rats, dogs, and stray hogs. From this plat most of the laboratory tests will be made during the coming year.

The varieties planted are Negros Purple, Yellow Caledonia, Formosa, Inalmon, Tigbao Mestiza, H–309, H–27, H–69, H–20, H–16, H–227. Adjacent to, and as a continuation of this plat, are the four "Luzon" varieties and D–1136, but as they were planted at different dates they cannot enter into this test.

During the past planting season requests for cane points of imported varieties were received from ten different planters. This indication of a growing interest in improved varieties on the part of the planters is encouraging.

Measurements showing the growth of sugar canes in "sugar-cane experiment No. 4," planted February 7, 1913.

	Mar. 22.	Apr. 10.	May 3.	May 13.	June 16.
	Meters.	*Meters.*	*Meters.*	*Meters.*	*Meters.*
H-227	1.01	1.39	1.53	1.83	2.61
H-16	.80	1.22	1.60	1.88	2.63
H-20	1.02	1.22	1.24	1.63	2.64
Rose Bamboo	.70	1.42	1.98	2.16	3.06
H-69	.84	1.29	1.47	1.60	2.30
Tigbao	1.12	1.51	1.88	2.31	3.26
Formosa	.63	1.37	1.65	1.78	2.39
Lahaina	.93	1.14	1.32	1.67	2.92
Inalmon	.91	.99	1.55	1.78	2.51
Yellow Caledonia	.96	1.29	1.98	2.33	3.11
H-27	1.03	1.50	1.65	1.75	2.79
Striped Louisiana	.76	1.17	1.78	1.98	2.61
H-309	.53	1.32	1.57	1.93	2.34
Negros	.94	1.22	1.70	1.98	2.82

DIVISION OF HORTICULTURE.

The work of the division of horticulture includes the supervision of the Singalong experiment station, the Lamao experiment station, and the Ilagan tobacco station; seed and plant introduction and distribution; the locust campaign, and other entomological work; and all horticultural investigations.

During November, 1912, a photographic office was instituted in the division of horticulture. It is estimated that this office is now turning out work at less than one-half the cost for the same work done outside the Bureau. During the fourth quarter no less than 3,000 prints have been made, besides the other routine work.

The work of collecting market reports and horticultural crop statistics has been carried nearly to a close during the year. The records and statistics obtained are being tabulated and the results will be ready for publication during the coming fiscal year. This is the first census to be made, so far as known, of Philippine fruits. These market reports show in detail the cost and the regular season of each fruit and vegetable to be found in Manila.

Official inspection trips have been made to Mindanao and the southern islands by the chief, the horticulturist, and the assistant horticulturist. The entire staff of the locust office, with the exception of the clerks, have made tours of inspection in the Visayan Provinces, in Palawan, and in southern and central Luzon.

Exchange relations have been maintained with 58 agricultural or botanical stations in 28 foreign countries and from nearly all of these exchanges valuable material has been, or

probably soon will be, received. An exchange of agricultural photographs has also been organized with several foreign countries.

SINGALONG EXPERIMENT STATION.

About 2,000 tests of over 1,000 varieties of vegetables and forage plants more or less adapted to Philippine conditions have been made during the year at Singalong. Simultaneously with the vegetable tests it was found expedient and economical to run a number of ornamental tests in ground which was not at that time occupied by the vegetable tests. This feature has furnished some of the most striking results obtained; several hundred first-class varieties of cannas, dahlias, and hardy bulbs capable of enduring the Manila climate have been introduced into the Philippine flora. Many of these, like the canna, are a very great improvement over the three or four old varieties which were in evidence before the Singalong tests began, and are as readily propagated. These ornamentals which have been propagated at very little expense will be distributed to various Government institutions, such as hospitals, the larger schools, demonstration farms, city plazas, etc., throughout the Archipelago during the coming fiscal year.

The most important part of the propagation work at Singalong has been the germination and growing of seeds and plants for the Lamao experiment station. During the year about 200,000 seedlings have been raised in the main propagation shed. There are now 1,700 varieties of seeds and plants in process of propagation in about 250 flats, or seed boxes, and beds, besides 300 varieties of plants in the sheds themselves. Besides the very large number of miscellaneous seeds and seedlings sent from Singalong to the Lamao experiment station, the records show that no less than 11,458 plants have been furnished Lamao from the propagation sheds of Singalong. It is estimated that the total number of roots, bulbs, cuttings, and living plants handled and distributed this year from the Singalong propagating sheds is upwards of 400,000, exclusive of mulberry cuttings, yam tubers, taros, and vegetable seeds.

During the fourth quarter a temporary half-shade bamboo shed was provided for housing the rapidly growing orchid collection. This shed now contains upwards of 600 plants which are being "settled" and fed up, to be used later as exhibits in the exposition in 1914.

The principal economic collections now in evidence at Singalong are the following:

A collection comprising over 50 numbers of yams; this represents the old Philippine yam collection combined with a number of excellent new varieties received during the past year from foreign countries. The surplus material from this collection was sent during the second quarter to the Lamao experiment station for wholesale propagation, three typical specimen plants of each variety being retained for synonymy and botanical study.

Besides the old collection of taros, dasheens, and yautías, 9 varieties new to the Philippine Archipelago have been received from the United States Department of Agriculture. The 14 principal economic varieties of this group of rootcrops, most of which are new to the Philippines, are now being propagated on a large scale for future distribution; a considerable number of presumably valuable sorts are under test.

Nearly all of the bananas which are to be tested under project 29 at the Alabang stock farm must needs pass through the Singalong propagating sheds; over 200 varieties and species have been put into proper shape for distribution at Singalong and 134 of these have been permanently set in the trial ground at the Alabang stock farm.

Excellent success has been met with in the propagation of newly introduced varieties of mulberries, and at the close of the year a large stock is ready for permanent planting and wholesale propagation at the Lamao experiment station. There seems to be no question that three if not five of the new varieties will prove greatly superior to the varieties distributed to silkworm raisers during the past year.

On the whole, there have been remarkably few negative features in evidence at Singalong during the past year; on the other hand, an unexpectedly high percentage of successes—considering the difficult nature of much of the work—has been obtained. The cost of the work has been remarkably low and the future importance of it will be more in evidence during the coming two or three years.

LAMAO EXPERIMENT STATION.

The cultivable portion of this station has been divided into 7 natural fields and these again into 14 subdivisions in order to differentiate the various lines of work more thoroughly than heretofore. The propagation work is rapidly assuming very large proportions and with the coming popularity of citrus fruits

throughout the Archipelago every effort is being made to test, propagate, and distribute a very large number of the best citrus fruits in the world. The work on the mango orchard has not progressed far yet on account of the pressure of other work, but this and work with the spices, bananas, mulberries, etc., will begin early in the coming fiscal year.

Among the fruit collections now most in evidence is that of the Annonas and Annona hybrids. Mr. Wester has made a special study of these fruits, which bid fair to be of the highest importance in the future horticulture of the Philippine Islands, and already a number of promising crosses between the Philippine and introduced species have been made. The most important of these hybrids are the 23 Cherimoya-sugarapple crosses which were large enough to fruit this year, but which were "set back" on account of their being transplanted into a permanent plat during the third quarter.

The miscellaneous tropical-fruit collection has been greatly increased during the year and now contains representatives of nearly all of the best tropical fruits of both the Western and Eastern Hemispheres.

The citrus collection has been started in plantation form, the trees being set 8 by 4 meters. Two trees of each variety on the same stock are planted with the expectation of removing every other tree as they attain full size. In the main field a variety of promising stocks will be tested in order to determine the degree of congeniality between the bud, or scion, and the stock plant. Most of the stock species under test are native to the Philippines.

Twenty-seven varieties of Philippine citrus fruits are in the nursery awaiting transfer to the test orchard, while 44 citrus varieties collected in the Philippines are already in evidence in the permanent field. All the standard citrus varieties of America and India are now under observation and most of the European varieties will soon be in evidence. The collection of citrus seedlings comprises some 90 numbers, probably more than one-half of which belong to different types of citrus fruits and most of which require nothing but good horticultural treatment to develop their innate good points, which means that in this seedling collection there are undoubtedly several fruits of first-class value which will be not only of much interest to the scientist but of profit to the producer. It is expected, moreover, that fully 75 per cent of the introduced varieties of oranges, lemons, limes, and pomelos will prove adaptable to Philippine conditions.

Previous public opinion to the contrary, it has been practically

proved that there are no peculiarities about the climate or soil of the Philippines to preclude the successful practice of shield budding of even such difficult species as the tamarind, cashew, custardapple, soursop, etc.

The pineapple collection comprises Cayenne, Spanish, and Queen plants in large numbers for distribution, and at present the varieties Abakka, Sugarloaf, and the famous new Webber hybrids will be forced as rapidly as possible.

Some 400 avocado seedlings are being grown as stocks in anticipation of the receipt of a very large collection of avocado budwood of the best varieties in the world from the United States Department of Agriculture.

Of the mango collection received from India last year 21 varieties are now growing in the plant shed and are being inarched onto stronger stocks—a very necessary procedure—as rapidly as possible; these India mangos, together with a collection now at the Singalong experiment station, will be transferred soon to the permanent mango orchard.

The papaya breeding work has progressed during the year to a point where wholesale distributions of seed of a superior new hermaphrodite variety (showing almost no male plants) are being made. Several new methods of propagation are being tested; and a new type of these fruits has been discovered.

The very large collection of vanilla varieties was transferred from Singalong to Lamao in the fourth quarter. A field has been reserved for a trial vanilla plantation where shade or nurse trees will be tested, and at the end of the coming fiscal year it is probable that definite information concerning vanilla culture in the Philippines can be given out.

The propagating sheds and nurseries contain a vast number of plants of the principal economic fruit trees of the Tropics. There are now 1,300 budded citrus trees with over 12,000 seedling stocks awaiting buddage, besides some 6,700 plants of miscellaneous sorts.

The mulberry field has been remodeled and the old trees which have been badly weakened by repeated pollarding (for distribution of mulberry cuttings) are now in a way to rejuvenate themselves within a few months. The old variety (655 trees) is being replaced by the new varieties as rapidly as possible. Already 150 plants of new varieties are in place. Some 30,000 mulberry cuttings were distributed during the year.

Little experimental work has been done with the fiber plants, although about 20,000 maguey suckers, 4,300 sisal suckers, and 30,000 sisal bulbils have been distributed from the station.

About 100 varieties of vegetables have been tested, mostly in large plat form, during the year, and of the beans, okra, etc., a considerable quantity of produce has been turned back to the central office at Manila for general distribution. Considerable work has also been done with new cover crops, the idea being to publish the results of these tests and to grow seeds in bulk for general distribution during the coming year. The yam collection now includes 70 accession numbers and occupies a space of 1,260 square meters. The preliminary tests of the Singalong experiment station are being continued at Lamao and surplus material, of which there will soon be a great quantity in evidence, will be utilized in the regular plant and seed distribution work of the main office. Work with roselle has progressed very well, indeed, and 43 kilos of seed are now ready for distribution. Several fiber varieties of this popular crop have been tried out.

ILAGAN TOBACCO STATION.

Throughout the year coöperative demonstration and extension work in Isabela and Cagayan Provinces has been maintained through the station's traveling inspectors. Some work in the way of experiments and tests with vegetables, maize, tobacco, etc., at the station in Ilagan has been undertaken.

The cultivable ground at the station has been platted into separate fields, and careful records are kept of the crop tests in each of these areas. Incidentally, several hundred packages of vegetable, flower, and forage seeds have been distributed from the Ilagan station to Filipino planters in the valley; and seventy-six planters selected as collaborators have been furnished with seed maize. Besides detailed instruction in tobacco growing, the traveling inspectors advise and instruct the Filipino planters in maize culture, vegetable growing, and selection of seed.

SEED AND PLANT DISTRIBUTION.

The seed-distribution office has carried considerably more seed stock than during the previous year. The varieties of seeds handled have been about trebled and the quantity has nearly doubled that of the previous year. Special attention has been given the needs of planters having a considerable area under cultivation. The number of special collections distributed to provincial governors, supervising school teachers, hacenderos, and planters collaborating with this division is something over 1,600. The quantity of material in these special collections varies from 50 packages of seeds to bulk lots of 25 or more kilos (representing a very considerable expense), but it is believed

much more good to the agriculture of the Philippines has been done through this system of distribution than through all the other methods combined, for the reason that the recipients have been intelligent planters, keenly interested teachers, or Government officials who were active in developing interest in new vegetables and forage crops among the planters in their districts.

About 12,000 collections have been mailed upon request from this Office; this represents about 125,000 packages of seeds, most of which were vegetables that had been tested and found adapted to Philippine conditions. One thousand six hundred forty-seven collections of seeds were called for at the mailing room of the central office in Manila. The provinces requesting the most collections were, in order of importance: Pangasinan (2,022), Ambos Camarines (1,331), Bulacan (1,270), and Union (1,138).

Besides the seeds purchased abroad for distribution through this Office, a very considerable quantity grown at Lamao has also been handled and much is still in stock for the coming fiscal year. Some 30,000 cuttings of mulberries have been distributed through this Office, together with about 1,000 pineapple suckers, some 28,000 sisal bulbils, and several thousand maguey and sisal suckers.

The germinating tests of seeds of uncertain quality are made both at the Singalong experiment station and at the central office. In this way very little seed that does not germinate above 75 per cent is allowed to go into general distribution. Most of the adverse reports concerning the germinating qualities of the seeds distributed by this Office have been found to be unreliable; that is, through accident or ignorance on the part of the recipient the seeds were either *prevented from germinating* or the seedlings were killed within one or two days after germinating. Very few complaints have been received concerning the seeds distributed during this year—a considerable improvement in this respect over last year; on the other hand, many complimentary letters have been received from provincial officials and prominent planters indicating the reliance placed by them on the materials sent out by this Office.

BANANA AND TROPICAL-FRUIT COLLECTION.

At present some 134 varieties of bananas and plantains are in evidence in the Alabang collection. Another large lot is due to be set out very soon. Of the more important varieties space for three stalks is reserved; for others only one or two stalks are allowed. On account of the rapidity with which this collection has been built up the space reserved has already been

filled and a part of the ground set apart for the permanent tropical-fruit collection has been set with bananas.

Circular letters have been sent out to municipal presidents in districts which it is believed may contain varieties of bananas not found in central Luzon. Replies and materials are beginning to come in at the close of the year in answer to these requests. Letters have also been sent to horticulturists and planters interested in bananas throughout the Old World Tropics. Through the regular exchanges of the Bureau and by means of these letters requesting special exchanges in the line of bananas it is believed a nearly complete collection of the world's best bananas and plantains can be assembled within three years. Already over 200 numbers have been listed, care being taken not to give two numbers to one variety unless the names are so very distinct that there is little chance of their being synonymous.

There are two objects in making this collection of bananas—the working out of the synonymy of the varieties, which it seems has never been done by any country to date; and a thorough test of economic varieties for their commercial possibilities. It is believed there is an excellent opportunity here for banana cultivation on a large scale and no tests of the apparently suitable varieties having been made thus far, it is impossible until the close of work under this project to make any definite conclusions. There is not much doubt but that the present collection is the largest collection of economic Musa varieties in the world.

TROPICAL-FRUIT INVESTIGATIONS.

The principal feature of the work of this division is without question the citrus investigations. Practically all the citrus work is now confined to the Lamao station, although in some cases difficult propagation work has been conducted at the Singalong experiment station. The most important introduction is believed to be the seedless Siamese pomelo introduced during the first quarter by the assistant horticulturist.

Another collection of inarched mangos has been received during the third quarter from Calcutta, India; this collection which arrived in a precarious condition is still at the Singalong experiment station. Preparations have been made for extensive mango propagation during the coming fiscal year. The India mango varieties received during the previous fiscal year are now being propagated at the Lamao experiment station.

The collection of avocado varieties (46 distinct sorts) received during the first quarter has not progressed favorably.



Moro maize at Singalong experiment station yielding 9,750 liters per hectare.



Mungo grown as a cover crop in rice field during dry season.



Propagating house at the Singalong experiment station; for valuable plants which require special treatment (constant humidity and even temperature).



(*a*) Mangosteen (*Garcinia mangostana*), Dumaguete, Oriental Negros. The world's best fruit.



(*b*) Siamese seedless pomelo (*Citrus decumana*) recently introduced from Siam. One of the excellent varieties which, it is believed, will revolutionize the pomelo industry of the world.

Due to improper stocks, lack of irrigation facilities, and a very dry period at the time of budding, most of this collection was lost. It is expected the collection will be duplicated early in the coming year. A considerable number of surplus seedlings have been distributed from the Lamao and Singalong experiment stations. A new lot (500 fruits) has also been ordered from Hawaii.

The papaya work is progressing favorably. Selective work with seedlings has been continued throughout the year and a variety carrying about 95 per cent of hermaphrodite plants has been "fixed." Seeds of this variety are now being sent out to schools and planters. The old plantation at the Alabang stock farm is still under observation.

No special banana investigations have been made thus far, but as soon as the large collection at the Alabang stock farm begins to fruit, technical work carried under this project will begin.

Beyond the propagation of a number of cacao seedlings for future investigations no special work with this crop has been done this year. The collection of pineapples is gradually increasing and distribution is now being made of the Queen; the Cayenne and Spanish varieties will be in condition for distribution during the coming year.

ROOT CROPS AND VEGETABLES.

The collection of yams at both the Singalong and the Lamao experiment stations is gradually increasing, and of most varieties suitable for distribution a large stock is now being grown for the coming year's work. The aroid collection maintained at Singalong thus far will soon be in condition for general distribution. Of the native Philippine vegetables special attention has been given the asparagus pea, or "seguidillas." A large number of seeds of this interesting vegetable have been grown at Lamao and are now being distributed.

SPICES.

A collection of vanilla varieties believed to be the largest in the world has been transferred from Singalong to the Lamao experiment station. A small plantation has been started with the object of testing the suitability of various shade trees for this valuable crop. A few of the spices, such as cardamum, cubeb pepper, black pepper, etc., have been received and will be propagated as rapidly as possible.

APICULTURE.

During the first quarter one weak colony was received from Hawaii and during August six colonies were received from Guam. These latter were in much better condition than the first lot and it has been arranged now to have another shipment come during the first quarter of 1914 from the Guam experiment station. There are now at the Lamao experiment station five colonies in fair condition. An apiary was constructed at Lamao during the second quarter. At present there are at the Alabang stock farm two colonies in fairly good condition.

Thus far it appears that the imported bee colonies have no pests or diseases and the future outlook is very favorable for the successful introduction of bees throughout the Philippines.

LOCUST EXTERMINATION.

The work of the locust office, while maintained from specially appropriated funds outside of the Bureau's regular appropriation, has been throughout the year under the charge of the chief of the division of horticulture. In the first quarter of this year both the entomologist and the assistant entomologist made extended tours through the infested provinces and at intervals this policy of periodical trips of inspection has been followed. In the latter part of the fourth quarter two agricultural inspectors were transferred from the veterinary division to assist in the control of the locust pest.

During the fourth quarter very severe outbreaks of migratory locusts appeared in eastern and southern Luzon, coming apparently from northern Tayabas. By June 1 practically all the provinces of central and southern Luzon, with the exception of Zambales, had been invaded by flying swarms and at the close of the year not only these provinces but practically all others (33 out of 38) were infested more or less with one or more species of locusts. In some provinces, such as Tarlac, Nueva Ecija, and Rizal, the infestation is so wide spread that it must necessarily be a question of months, if not years, before the uncultivated fields and cogonales are completely cleared of the breeding swarms which, although quite exterminated in the cultivated areas, persist in these back districts and resist all regular measures of control.

During May and June a thorough study of the two species of bacilli parasitic in the migratory locust has been carried out

in collaboration with the Bureau of Science, the Bureau of Agriculture furnishing from one to three men and the many thousand living specimens of locusts for the laboratory experiments, while the Bureau of Science furnished the laboratory apparatus, exclusive of breeding cages, etc. Neither the so-called *Coccobacillus acridiorum* of the Pasteur Institute nor a similar microbe discovered in dying grasshoppers taken at Alabang have given consistently satisfactory results in the field. During June a full series of experiments with cultures of these bacilli were carried out in the vicinity of Cabanatuan, Nueva Ecija, but with a few exceptions the vitality of the bacilli outside of laboratory conditions deteriorates so rapidly that this very interesting and promising method of locust control has been abandoned as a general measure. Whereas laboratory methods were potent in securing the destruction of practically any number of individual locusts within a few hours after inoculation, on only two occasions in the field tests did the experimenters succeed in contaminating entire swarms under natural conditions.

MISCELLANEOUS ENTOMOLOGICAL WORK.

Aside from the locust-destruction work a large amount of insect-pest work has been carried out by the locust office. Considerable work has been done in white ant, or termite, control methods. Several new coconut pests have been studied, their life histories worked out, and, in one case, that of the leaf-miner (*Promecotheca cumingii* Baly), published in the Review and reprinted in the Philippine Journal of Science.

An article on the tobacco-leaf caterpillar (*Prodenia litura* Fabr.) is in press. An important piece of work with the mango bark-borer (*Plocaederus ruficornis* Newm.) has been performed and a very destructive pest to one of our most important fruit and shade trees has been controlled just in time to prevent very severe losses. Several other mango pests have been investigated. Maize and rice insects have come in for a fair share of the locust office investigations, while shade-tree and garden-truck pests have been given a moderate amount of attention. Two new citrus pests and a banana rootborer have been studied and considerable matter is nearly ready for publication. Over 700 insects have been added to the economic collection and sets of these for determination have been and are being sent to the United States Bureau of Entomology, Washington, D. C., for determination.

FIBER DIVISION.

The work of the fiber division includes investigations pertaining to abacá, agave, and allied fibers, kapok and allied flosses, cotton, Philippine hats and mats, and miscellaneous fibers. These general lines of activity are carried on by two methods of procedure, namely, experimental and field investigations.

ABACÁ (MANILA HEMP).

Abacá varieties.—This study was commenced during the fiscal year 1910, and has been continued until the present time. During 1910 and 1911 the study was restricted to the determination by field investigations of the varieties in each of the chief abacá districts, which was intended to serve as a basis for a more comprehensive study by means of experimental planting of the principal varieties from some of the above-mentioned districts at the La Carlota experiment station. The object of such work is fourfold: First, to determine accurately the distinguishing characteristics of each of the varieties; second, to determine whether or not the varieties of one district are identical with those of another; third, to determine to what extent, if any, the change of environment affects the growth of the plants and the quality of the fiber; and, fourth, to show whether the varieties reproduced from seed will exhibit the same characteristics as when reproduced from rootstocks.

During the fiscal year 1912 rootstocks from the most widely cultivated varieties of southeastern Mindanao and northeastern Leyte were secured and planted at the La Carlota experiment station, each in a separate group of plats. Seed from each of the varieties of southeastern Mindanao was also obtained at the same time as the rootstocks, and was germinated in a nursery.

During the year covered by this report the seedlings of the above varieties were transplanted to a group of plats opposite the one in which the same varieties from rootstocks were previously planted. Seeds from the ten Leyte varieties were also obtained and germinated in a nursery. In addition to the above, rootstocks from eight varieties from Ambos Camarines, namely, Pula, Itom, Puti Tomatagacan, Bulao, Ilayas, Sinamoró Puti, Canorajon, and Sugmod, and also rootstocks from five varieties from Occidental Negros, namely, Kinisol, Kala-ao, Bisaya, Lonó, and Moro, were secured and planted in two groups of plats in the same manner as the southeastern Mindanao and Leyte varieties. Seed from the Camarines and Negros varieties was also obtained and germinated in the nursery, and the seedlings will be later transplanted each to a group of plats set aside for them.

With the exception of the failure to germinate the seed from the Bangulanon and Sinabá varieties of southeastern Mindanao, from the Laguis, Liajon, and Ite-hen-Balud varieties of Leyte, and from the Ilayas and Pula varieties of Ambos Camarines, the plants from rootstocks and the seedlings have all made very fair progress, notwithstanding the drought and typhoons that have occurred during the year. The periodical use of the cultivator, the planting of leguminous cover crops, and periodical irrigation during the dry season have been resorted to and have proved to be indispensable methods of culture especially during such adverse circumstances as have been encountered during this year and the latter part of last year.

Of all the varieties which have been planted at La Carlota, the Mindanao varieties alone are now old enough to begin to exhibit some of their distinguishing characteristics. During the next fiscal year, it is believed that the Leyte varieties will be old enough to permit of a comparative study with the Mindanao varieties.

Cultural methods.—The improved methods of culture which have from time to time been recommended by this division have not yet been as widely adopted as might be desired. The severe drought of 1912 afforded a splendid object lesson in favor of the use of modern methods of culture, it having developed that, in the districts where the majority of the plantations were severely damaged, the well-managed plantations resumed their normal condition of growth and production in a comparatively short period. It has also been demonstrated that the damage to the abacá plantations during and subsequent to the drought was due more to utter neglect of the plantations in some cases and to the practice of ruinous methods of culture and harvesting in others than to the actual effects of the drought itself.

The various methods of culture which have been persistently recommended by this Bureau, such as systematic planting, the use of cultivators, the interplanting of leguminous cover crops, and the renewal of old plantations, will all be tried in a thorough manner at the demonstration stations which the demonstration and extension division of this Bureau proposes to establish in the principal abacá provinces during the coming fiscal year. It is believed that these demonstrations will convince many planters of the advantages of employing such methods and will finally lead to a general substitution of these for the wasteful, inadequate, and ruinous methods now in general use.

Quality of the fiber.—The average quality of abacá throughout the Archipelago remains low and far from satisfactory. It is

difficult to estimate the production of abacá by grades, as droughts, typhoons, market conditions, and the established custom of the producers in certain provinces or in certain localities in the same province, all tend to cause variation in the quality of the fiber turned out. It is roughly estimated that during the last year the Albay crop averaged between good and superior seconds; the Camarines crop, fair or good seconds; the Sorsogon crop, about 25 per cent over current or midway; the Leyte crop, current U. S.; the Samar crop, midway, or 75 per cent over current; the northern Mindanao crop, about current or 25 per cent over; and the southeastern Mindanao crop, good current or 50 per cent over.

The exports of abacá are not tabulated according to grades and, therefore, the exact figures showing the proportion of the exports of each grade to the total are not available. From figures obtained from some of the principal exporting houses in Manila, however, it has been possible to give an approximate estimate, which it is believed cannot be far from correct. These figures show that the exports by grades during the calendar year 1912 were as follows:

	Per cent.
Best and good grades, from 50 to 300 per cent over good current	10
Good current grades, from 75 per cent over current to 25 per cent over good current	18
Current grades, from current to midway	40
Low grades, from fair brown (red) to superior seconds	32
Total	100

The tests made at various times by the fiber division have demonstrated that the fiber carefully extracted and properly handled prior to and after extraction averaged approximately as follows:

	Per cent.
Best and good grades, from 50 to 300 per cent over good current	60
Good current grades, from 75 per cent over current to 25 per cent over good current	25
Current grades, from current to midway	10
Low grades, from fair brown (red) to superior seconds	5
Total	100

A comparison of the above tables clearly indicates the extent to which the quality of the fiber may be improved by the practice of a more judicious method of extraction and by careful handling. It must be admitted, however, that for several reasons such progress is difficult of accomplishment, though a considerable advance can, and should, be made.

Effect of 1912 drought and typhoons on production and value of abacá.—A year ago the Philippine Islands were emerging from the ravages of a prolonged and unusually severe drought. In the fall of 1912 two severe typhoons occurred, which caused considerable damage to abacá, principally in the Province of Leyte. Early in May, 1913, another typhoon occurred which passed through Albay, southern Samar, Leyte, Mindoro, and the Ilocos Provinces, all of which with the exception of the last two are important producers of abacá.

From estimates made by the chief of the fiber division, based on personal field investigation, it would appear that a shortage of 30 to 35 per cent in the total production for the Islands can be reasonably expected to occur, taking effect during January, 1913, and extending to May or June, 1914. This estimate, however, may possibly be reduced, owing to the fact that a large number of plantations which had been almost utterly neglected before the recent considerable rise in the price of abacá have again been brought under cultivation.

Summing up the whole situation as it now stands, and taking into consideration every factor which tends to accelerate or counteract the effects of the drought and typhoons of 1912, it is believed that the production of abacá may be safely estimated at 145,000 metric tons for the fiscal year 1913, or about 10 per cent less than 1912; and at not less than 105,000 to 110,000 metric tons for the fiscal year 1914, or about 35 to 30 per cent less than 1912. The quantity available for export is usually five to ten thousand metric tons less than the actual production.

The exports during the fiscal year 1912 were 154,046,928 kilos (154,047 metric tons) valued at ₱32,567,020, or an average value of ₱21.20 per 100 kilos. The exports for this fiscal year are estimated at about 140 million kilos (140,000 metric tons), valued at about 45 million pesos, or an average value of ₱32 per 100 kilos. The rise in value began in July, 1912, and reached its maximum in January, 1913, when good current sold in the Manila market at ₱53.50 per 100 kilos. Since January, however, the price has gradually declined and at the present time the daily quotations give good current at about ₱40 per 100 kilos.

Abacá machines.—The machines mentioned in previous reports have not come into general use. This failure is due, in most cases, to their low capacity, complexity of construction, and to the high cost of operation. An abacá-cleaning machine, which appears to be very promising, has recently been brought to Manila from the United States. No official tests of this machine have yet been made.

Knotted abacá.—This industry has continued to develop, and it now forms one of the chief home industries in Cavite, Batangas, Iloilo, and other provinces. The exports of abacá of the finest grades to Japan and Europe where the fiber is knotted and manufactured into hat braids and other textile articles have also continued and have probably increased over last year.

AGAVE AND ALLIED FIBERS.

Maguey (cantala) and sisal.—There has been no change in the status of this industry during the year. Both maguey and the true sisal continue to be planted in small and scattered areas principally as an emergency crop. The present condition of the plantations does not permit the use of machinery for extracting the fiber, and the "retting" method is still practically exclusively used.

Distribution of suckers and bulbils.—Owing to the rise in the price of maguey during the year, there has been more demand for suckers and bulbils than during the last three or four years. About 30,000 bubils and 10,000 suckers of sisal and 10,000 suckers of maguey have been distributed during the year. Requests from provinces where plantations of maguey or sisal are found were not filled, but referred to the localities where plants can be obtained.

Production and value.—The demand for maguey and sisal during the year has been brisker than for several years before. This was due to the expected shortage in the production of abacá, on the one hand, and to a strong demand in the United States for binder twine, on the other. The Philippines reaped their share in the rise in the prices of the so-called sisal fibers, which fact is shown by the substantial increase in the quantity and value of maguey exported during the year. During the fiscal year 1912, 4,593,226 kilos (4,593 metric tons) of maguey, valued at ₱641,942, or an average of ₱14 per 100 kilos, were exported from the Philippines. During this year the customs figures give the exports at 8,335,823 kilos (8,336 metric tons), valued at ₱1,408,788, or an average of about ₱17 per 100 kilos.

Enemies and diseases.—No new enemies nor diseases of the maguey and sisal plants have been discovered during the year. The fungus disease discovered last year on sisal leaves at the Lamao experiment station has been identified by the mycologist of the Bureau of Science as *Diplodia agaves* Niessel. The spores of this fungus arrange themselves in oval concentric bodies. This disease does not appear to spread easily and there does

not seem to be any difficulty in checking it, which can be done by cutting the leaves as soon as its appearance is detected.

Agave and Furcroea introduction.—It has been desired to make a thorough study of all the commercial species of Agaves and Furcroeas for the purpose of ascertaining the relative merits of their fibers and other matters connected with their habits of growth and cultivation, and at the beginning of this year this work was commenced.

To carry on this work a section of land at the La Carlota experiment station was set aside and divided into as many plats as there are commercial species in the two genera in question. The following plats, which consist of 4 rows 30 meters deep each, were planted during the year: Maguey (*A. cantala*), sisal (*A. sisalana*), henequen (*A. fourcroydes*), zapupe (*A. zapupe*). an agave species not yet determined, and Mauritius hemp (*F. foetida*). The henquen and Mauritius hemp bulbils were obtained from Porto Rico. The zapupe suckers were obtained from plants grown here and introduced from Mexico in 1905. An attempt will be made this year to obtain bulbils of the remaining commercial species of the two genera.

KAPOK.

Status of the industry.—A decided impetus has recently been given the kapok industry, which is manifested by the establishment of several plantations in central Luzon. Without the establishment of such plantations where modern methods can be used for cleaning and baling the floss, it would be impossible for the industry to develop to the extent warranted by the admirable quality of the floss and its utility in several important manufactures. The demand for Philippne kapok has recently considerably increased, but the local facilities for its preparation and transportation are inadequate to meet the requirements of the industry. The progress of the industry will necessarily be slow until the plantations shall have attained the producing stage.

COTTON.

In October, 1912, the fiber division started experimental work in the growing of cotton at the La Carlota experiment station. During the fiscal year 1912 a preliminary investigation had been made for the determination of the native species of cotton grown throughout the Islands, the results of which were given in the last annual report. Seeds of these species were obtained for planting during this year. Early in 1912 seed of thirteen types

of cotton, mostly American upland, were obtained from the United States Department of Agriculture. These, with seed of three varieties of Caravonica cotton which had been previously obtained by this Bureau, were planted at La Carlota about the middle of October. Shortly after the seed was planted a typhoon washed off part of the soil and carried away or mixed the seed. The second planting toward the end of October was made, which was again considerably hampered by heavy rains which accompanied the November typhoon. The following is the summary of the results obtained from the year's work.

American upland cotton.—Of these types of cotton the following were planted in separate plats in the following order: Hartsville, Shankhigh, Trice, Triumph, Lone Star, Saunder's 3, Lanquin, Acala, Durango, Columbia, Foster, Allen, and Egyptian. This seed was received shortly after the planting season of 1911, and was consequently somewhat old when planted this year. It was probably for this reason that the Triumph, Saunder's 3, and Egyptian failed to germinate. The other types germinated fairly well, though the succession of floods considerably reduced the stand.

All the types which germinated made a very fair growth and blossoms commenced to appear during the month of January. The cotton bolls reached maturity during April and May. During the early development of the bolls, they were profuse and very fair crops would have been obtained had it not been for the ravages of weevils and other insect pests. The weevil trouble assumed such a serious stage that a boll rarely reached the picking stage in a perfect condition. The crop therefore was a total failure, and nothing was obtained except very few bolls for specimens and for seed.

Toward the end of February the foliage of all these types was attacked by a rust which soon after spread so as to include the leaves of almost every plant. Specimens of these infected leaves were secured and the disease was later identified by the mycologist of the Bureau of Science as in all probability *Uredo gossypii* Lagerh.

Native species.—The following native species of cotton were set out in plats at the same time as the American upland types: Toguillo (kidney-cotton), Gapaz Kinachila, Taal, and Gapas Sanglay, or Candava (brown cotton). Of these the Taal seed failed to germinate, while the rest made a splendid germination.

The three species which germinated made a very luxuriant growth, much superior to the American types. The blossoms appeared a few weeks later than the latter, and the bolls did

not mature until a month, and in the case of Toguillo and Kinachila six weeks, later than the American types. In point of yield the Toguillo and Kinachila, especially the latter, were much inferior to the American cottons, though the Sanglay compared very favorably with the latter. These native species were not seriously injured by the weevil which wrought so much damage to the American cotton. The rust disease also was totally absent except in some instances on leaves of the Sanglay.

Caravonica cottons.—The seed of the three varieties of Caravonica, namely, silk, wool, and alpacá, failed to germinate. An attempt will be made to obtain fresh seed for planting in connection with the next year's experiments.

Conclusions.—The general conclusions to be deduced from this year's experiments are the following:

1. The cultivation of American and other foreign species on a large scale from imported seed, at least in the vicinity of La Carlota, is an unsafe investment. This can probably be accomplished only after the seed has been selected from plants which have been thoroughly acclimated to local conditions, or after it has been improved by crossing with one of the native species.

2. Of the native species, the Toguillo and the Taal are the only two that can be recommended for cultivation on a large scale. Careful selection of seed will undoubtedly increase their yield.

3. The successful cultivation of cotton in the Philippines depends to a large extent on the proper time for planting. This varies somewhat with the different species, but the rule is the same, e. g., the seed should be planted so as to bring the plants to maturity not later than the middle of the dry season. After that period, heavy rains are liable to set in with such frequency as to impair the quality of the floss.

During the next year a more extensive line of experiments will be undertaken, and a cotton specialist is expected to arrive in time to take charge of this work. The same species and types will be planted again, together with new ones. Selection and breeding work will also be attempted with the view of improving the types already cultivated or originating new types which will, on the one hand, meet the requirements of the industry and, on the other, will also be adapted to local conditions.

MISCELLANEOUS FIBERS.

The object of the investigations with miscellaneous fibers is twofold: First, to introduce from foreign tropical and semi-tropical countries fiber plants of commercial value; and second,

to grow fiber plants, either native or introduced, the fiber of which has good prospects of becoming a commercial article. Of the large list of such fiber plants the following were tried during the year:

China grass (*Boehmeria nivea*).—A plat in the section of land set aside for miscellaneous fiber plants at La Carlota was planted from seed originally obtained from London, England. The first trial was made at the Singalong experiment station but owing to excess of moisture the plants did not do well. Although this species is not ordinarily grown commercially in tropical countries, it was thought advisable to give it a trial here. The tropical variety, the *tenacissima* (ramie or rhea) will be planted in an adjoining plat during the next year.

Roselle (*Hibiscus sabdariffa*).—Two tall varieties of roselle, the white and the red, have also been planted during the latter part of the year, but it is yet too early to give any statement as to their prospects. The seed was introduced from India.

Hibiscus cannabinus.—A very few plants of this species were grown at the Singalong and Lamao experiment stations. The plants made excellent growth, but the manner in which they were planted was not such as would produce the best results for fiber purposes.

Carludovica palmata.—Two plants of this species which had been grown at the Lamao experiment station from seed originally introduced from Panama were divided and about 30 shoots were set out. As soon as these are well established, they will be transplanted to La Carlota. Request for a sufficient quantity of seed has also been made, which will be planted in time for future distribution. The plant appears to grow luxuriantly in the Philippines, and with the skill of the Filipinos in the art of hat making, it is hoped that the Panama-hat industry may be successfully established here.

Anabú (*Abroma augusta*).—The best fiber produced by this native species has been reported to be suitable for most of the uses for which the India and Tientsin jutes are used. Seeds from a wild plant found at Lamao were planted during the year, and the seedlings are now about 12 to 15 centimeters high.

Sansevierias.—Plats have been prepared during the year for planting the following species of this genus: *S. zeylanica, S. guineensis, S. cylindrica,* and *S. sulcata.* The first species is grown extensively in the Islands as an ornamental plant. A few plants of the remaining species were introduced two years ago from the Singapore botanical garden and an attempt has been made to propagate them. It is believed, however, that

only the first two species may prove to be of commercial importance.

Ticog (*Fimbristylis utilis*).—Through the courtesy of the Bureau of Education seed of this sedge was obtained and planted in a fresh-water swamp at La Carlota. This seed failed to germinate. In November divisions of the root from the same species grown in the neighborhood of La Carlota were obtained and planted in an adjoining plat in the same swamp, and these have all grown luxuriantly. This method of propagation appears to be much more certain than propagation from seed.

DEMONSTRATION AND EXTENSION DIVISION.

The demonstration projects established during the fiscal year, 1912, in Cebu, Bohol, Iloilo, Capiz, Batangas, and the Mountain Province have made satisfactory progress during the past year. New projects have been started in Surigao, Rizal, Cavite, Laguna, and Bulacan.

On February 7, 1913, Act No. 2226, "An Act to establish stations for practical instruction in matters concerning agriculture and a system of agricultural demonstration and development," was enacted by the Third Philippine Legislature. This act provides for an annual expenditure of one hundred and fifty thousand pesos for coöperative demonstration work and assures the establishment of this work on a permanent and substantial basis.

The two main features of the demonstration work are the demonstration stations and the coöperative demonstration plots. The stations serve as a headquarters for the demonstration work in each district or province, while the demonstration plots make it possible to carry the work into each municipality. The stations that have thus far been established are receiving the cordial support of the people and more demonstration plots have been offered than there were inspectors to supervise. It has been fully shown that there is a strong demand for practical work of this character and it has been demonstrated that this work produces results more than commensurate with the expenditure required.

ILOILO-CAPIZ DEMONSTRATION PROJECT.

The demonstration and extension work in Iloilo and Capiz was organized as a project on July 1, 1912. During the following month the Iloilo quarantine station of the Bureau of Agriculture was transferred to the demonstration division to be used as a demonstration station. This station is two kilometers from the

city of Iloilo and is situated in a bend of the Jaro River. It contains 76,000 square meters of low and very fertile "gumbo" soil. The entire station has been fenced and a large part of it has been plotted and planted. Twenty cavans of selected Moro seed maize and forty cavans of maize for feeding the animals at the station have been harvested. At the close of the year fourteen demonstration plots at this station were planted to the following crops: Cowpeas, Virginia dent, and Moro maize, Hawaiian papayas, castor beans, American sweet potatoes, Sanford's white flint maize, New Era cowpeas, Mexican June maize, peanuts, rape, pineapples, and sugar cane. There are also three large fields planted in Moro maize and one large field in guinea grass and sorghum.

The Iloilo demonstration station is now in splendid condition and will produce a sufficient quantity of good seed for distribution throughout the two provinces. The work that is being carried on is attracting a great deal of attention and the station is visited by a large number of farmers and other persons interested in agricultural progress.

From May to December, 1912, 14 maize demonstration plots were planted and harvested in the Provinces of Iloilo and Capiz. During December, 1912, and January, 1913, 25 maize plots in Iloilo and 25 in Capiz were planted. These plots were harvested and a third series planted in May and June, 1913. It will be noted that during the past year three crops of maize have been grown on the Iloilo and Capiz demonstration plots.

When it is considered that the average production of maize per hectare for the Philippine Islands is 8.22 cavans, that maize planted the native way on river-bottom land in Panay gives an average yield of only 26 cavans and 23 gantas per hectare, and that maize from selected and tested seed planted on this same river-bottom land and cultivated under the demonstration methods produced 95 cavans and 16 gantas per hectare, it is evident that this work is badly needed and that it produces results. The highest and lowest yields from the 14 plots harvested during September and October, 1912, were 98 cavans and 31 cavans, respectively, per hectare. On all of these plots the yield was from 25 to 150 per cent more than that produced on similar land in the same locality where the native methods were used.

It is stated by officials of the Philippine Railway Company that, as a result of the demonstration work carried on by the Bureau of Agriculture in Panay, more shelled maize was shipped into Iloilo from Capiz and way points during the months of

August, September, and October, 1912, than had been shipped in the past three years. Farmers are now growing maize in the Provinces of Iloilo and Capiz who never thought of planting it before the demonstration work was established.

CEBU DEMONSTRATION PROJECT.

During the earlier part of the fiscal year, 1913, the Province of Cebu was infested with numerous swarms of locusts which destroyed the crops on many of the demonstration plots that had been established in this province. During October and November Cebu was visited by two extremely severe typhoons which devastated large sections of the island and did still further damage to the crops that were being grown for demonstration. Of 28 plots that had been planted during the latter part of the fiscal year 1912, 17 were entirely destroyed. The 11 plots that were harvested, however, gave an average yield of 59.1 cavans of maize per hectare, which was 81 per cent higher than the yields on adjoining lands cultivated by native methods.

It would be difficult to conceive of conditions more unfavorable than those under which the demonstration work in Cebu was carried on during the calendar year 1912. Within a period of twelve months the province was visited by most severe droughts, locust infestations and two destructive typhoons. The fact that under these conditions definite and positive results were obtained is highly encouraging.

During the second half of the fiscal year 1913 12 maize plots, 3 tobacco plots and several other miscellaneous plots have been under cultivation in Cebu.

In connection with the demonstration work, the inspector in charge of this project has carried on lecture work in different municipalities, has distributed a large quantity of seeds and plants and has furnished valuable assistance in the locust campaign.

BATANGAS DEMONSTRATION PROJECT.

In October, 1912, the Batangas breeding and demonstration station was established. This station furnishes an excellent example of the coöperative spirit that is now being shown in different provinces in the work of promoting agricultural improvement. The municipality of Batangas furnished a tract of land for the station and the province fenced this land, constructed the necessary buildings, and has supplied a part of the labor required for the operation of the station. The Bureau of Agriculture has furnished the superintendent and other em-

ployees, breeding animals and equipment. As a result of this coöperation the people of the province and the municipality are keenly interested in the work that is being done.

The major part of the work at this station has been the breeding work, which is covered by the report of the division of animal husbandry. Of the crops planted Moro and Iloilo maize have given fairly satisfactory results. Rhodes grass has done well and considerable seed has been saved. Guinea grass, sorghum, and cowpeas have all made a fairly satisfactory growth.

Arrangements have been made for planting demonstration plots in every municipality in the province after the opening of the rainy season. Forty plots have been selected, which are distributed among different crops as follows: Maize, 31 plots; rice, 3 plots; orange-tree pruning, 3 plots; and sugar cane, 3 plots.

MOUNTAIN PROVINCE DEMONSTRATION PROJECT.

The territory covered by this project includes the seven subprovinces of the Mountain Province and the Province of Nueva Vizcaya. These two provinces include not only a very large area, but also widely varying conditions ranging from those of the tropical lowlands found in the coast regions of Amburayan and Apayao to the approximate temperate-zone conditions found in the higher altitudes of the Mountain Province. Under these circumstances very careful judgement must be exercised in the methods used and in the distribution and planting of seed over this large area in order that the work done may be entirely suited to the local conditions of each particular district.

This project is supervised by an agricultural inspector with six assistant agricultural inspectors detailed in the different subprovinces. The most important feature of the work carried on under this project up to the present time has been the establishment of demonstration gardens at a number of selected points and a very wide-spread distribution of seeds and plants.

In the subprovince of Benguet the Trinidad garden is the headquarters for the demonstration work. Seeds and plants are grown at this garden and are distributed throughout the subprovinces by an assistant inspector. The very excellent gardens to be found throughout the municipality of Trinidad are one of the direct results of the work that has been accomplished in this section.

In the subprovince of Bontoc the demonstration work has been greatly aided by the local officials, who have placed the large jail garden under the supervision of the inspector of the



Abacá plant, 15 months old, "Bangulanon" variety of southeastern Mindanao, reproduced from rootstock. La Carlota experiment station, Occidental Negros.



Abacá plant, "Laguis" variety of northeastern Leyte, 11 months old, reproduced from root-stock. La Carlota experiment station, Occidental Negros.



Kidney cotton plant (native "Toguillo"), 5 months old. La Carlota experiment station, Occidental Negros.



Maize plot at the Santa Cruz demonstration station.



Endive and onion plots at the Santa Cruz demonstration station.

Bureau of Agriculture. This garden has been used as the headquarters for the demonstration work in this subprovince.

Other points in the Mountain Province at which demonstration work has been established are Natonin, Sagada, Lubuagan, Tagudin, and Quingan. During the latter part of the year an assistant inspector was detailed to carry on the demonstration work in the Province of Nueva Vizcaya.

RIZAL-LAGUNA-CAVITE DEMONSTRATION PROJECT.

The agricultural situation in the district which includes the provinces adjoining the city of Manila is somewhat different from that found in any other part of the Islands. This district has excellent transportation facilities and also access to the markets of the city of Manila. There is opportunity in the Provinces of Rizal, Laguna, and Cavite to carry on not only the ordinary lines of demonstration work, but also special work with market garden crops.

During the latter part of the year a demonstration project was established which includes these three provinces. A small coöperative demonstration station has been opened at Santa Cruz, Laguna, the land and fencing for this station having been furnished by the province.

At the close of the year 13 demonstration plots had been secured and planted in the Province of Rizal, 9 plots in the Province of Cavite, and 3 plots in the Province of Laguna.

AGRICULTURAL DEMONSTRATION CAR.

During the latter part of the year the Manila Railroad Company, at the request of the Bureau of Agriculture, offered to construct an agricultural demonstration car to be used along the railway lines on the Island of Luzon. This car is 14 meters long and 3 meters wide. The interior construction provides for exhibits of different crops, farm implements, photographs, charts, maps, etc., and has also sections that will be used in the distribution of seeds and publications. In connection with the other work of the demonstration car illustrated lectures will be given at the different places visited. At the close of the year this car had been completed and the exhibits were being installed.

DISTRIBUTION OF PUBLICATIONS.

All the publications of the Bureau of Agriculture other than the regular mailing list of the Philippine Agricultural Review, are distributed by the demonstration and extension division. The following statement shows the total number of publications distributed during the past year:

Bureau of Agricultural publications distributed during the fiscal year ending June 30, 1913.

	English.	Spanish.	Tagalog.	Cebuano.	Ilocano.	Ilongo.
Bulletins	6,909	1,131			5	
Circulars	3,617	3,571	234	707	24	50
Roselle circulars	407	455				
Kapok circulars		63	1			
Press bulletins	12	9				
Sugar handbooks	161	348				
Philippine Agricultural Review	3,529	1,071				
Reprints	202	7				
Sugar bulletins	429					
Indexes to Philippine Agricultural Review	80					
Total	15,345	6,655	235	707	29	50

DIVISION OF PUBLICATIONS.

The work of the division of publications covers the following: The publication and distribution of the Philippine Agricultural Review; the publication of bulletins, circulars, etc.; supervision of the Bureau of Agriculture library; miscellaneous printing on the planotype; and translations.

THE PHILIPPINE AGRICULTURAL REVIEW.

Previous to July 1, 1912, the Review had been distributed free of charge throughout the Philippine Islands, and in the United States and foreign countries as well, with the exception of a few paid foreign subscriptions. During the fiscal year 1912 an average of 3,350 English and 3,762 Spanish copies had been issued each month. Owing to the cost of this publication, the large mailing list, the lack of information in regard to the status of many people on this list, and the large number of requests for the Review received from persons whose status was not known, it was considered advisable to continue the free distribution to various Government officials, commercial firms, libraries, etc., and require all others to pay a subscription price, in the Philippine Islands and the United States of ₱2 and in foreign countries of ₱4. This policy has considerably reduced the mailing list, but has resulted in marked economy and a much more effective distribution of the Review.

During the fiscal year 1913 an average of 1,705 English copies and 1,438 Spanish copies were sent out.

The number of paid subscribers was much smaller than was expected, there being 172 subscribers to the English and 193 to the Spanish edition.

Two hundred and five English and 78 Spanish copies were sent out monthly in exchange for foreign and local periodicals.

Three hundred twenty-two English copies of each issue were

delivered to the Bureau of Education for distribution to school libraries throughout the Philippine Islands.

One thousand two hundred and twenty-four English and 1,167 Spanish copies were forwarded each month to Government officials and other persons on the free mailing list.

Owing to the large amount of material available covering special subjects, the general policy of devoting every other number to one single subject was instituted during the fiscal year. The following special numbers were issued: (1) Economic Horticulture, (2) Ornamental Horticulture, (3) Veterinary Number, (4) Annual Report 1912–13, (5) Fiber Number, (6) Demonstration and Extension Number.

During the fiscal year the monthly distribution of the English edition of the Review was as follows: Philippine Islands, 1,108; United States, 424; foreign countries, 391. The monthly distribution of the Spanish edition of the Review was as follows: Philippine Islands, 1,364; United States, 4; foreign countries, 70.

BULLETINS AND CIRCULARS.

Bulletins and circulars prepared in the various divisions of the Bureau are forwarded to the division of publications for editing. All expenses entailed in the publication of a bulletin or a circular are borne by the division from which it emanates.

The following bulletins and circulars, including reprints from the Review, have been issued during the fiscal year:

Bulletins, circulars, and reprints published during fiscal year 1912–13.

Subject.	Author.	Copies.	
		English.	Spanish.
BULLETINS.			
No. 22. Rice Culture in the Philippines	C. M. Conner	2,000	
No. 23. Corn Culture in the Philippine Islands	Sam H. Sherard	1,500	1,000
No. 24. The Role of *Stomoxys calcitrans* in the Transmission of *Trypanosoma evansi*.	M. B. Mitzmain	1,000	
No. 25. The Philippine Coconut Industry	O. W. Barrett	5,000	
No. 26. The Kapok Industry	M. M. Saleeby	2,000	
CIRCULARS.			
No. 16. Pineapple Culture	P. J. Wester	1,000	1,000
No. 17. Corn Culture	Sam H. Sherard	1,000	1,000
No. 18. Rice Culture	C. M. Conner	1,500	3,000
No. 19. Maize Pests	C. R. Jones	1,000	1,000
No. 20. The Mango Bark Borer	do	1,000	1,000
No. 21. Kapok Culture	M. M. Saleeby	2,000	2,000
No. 22. Maguey (Cantala) and Sisal Culture	do	2,000	2,000
REPRINTS.			
Data Concerning Varieties of Rice	C. M. Conner	500	
The Situation in the Citrus District in Batangas	P. J. Wester		300
Collected Notes on the Insect Transmission of Surra in Carabao.	M. B. Mitzmain	100	

PLANOTYPE.

Such printed matter as tabulations, cards, special orders, etc. of less than two pages in length of which not more than 2,000 copies are printed, and matter of a confidential nature or which is desired earlier than a delivery could be made by the Bureau of Printing, is turned out on the planotype. Printed matter not coming under this classification is forwarded to the Bureau of Printing.

During the fiscal year delivery was made on the following work orders: Manuscript, 111 orders; tabulations, 87 orders; cards, etc., 75 orders. This makes a total of 273 work orders and 253,715 copies printed.

LIBRARY.

In order to put the library work on a systematic basis, it has been entirely reorganized during the past year. The library was first classified and rearranged on the shelves and the catalogue begun. The Library of Congress scheme of classification was adopted, as this is the system used by the other government libraries.

A combined author and subject card catalogue is being made. It now consists of approximately 5,500 cards. In addition to the current material, all the bound volumes and single publications available, and a large number of serial publications, have been catalogued. About 119 new books have been received during the year.

The library is at present receiving about 230 periodicals, 22 of which are new subscriptions. This number does not include newspapers received as exchanges or otherwise. All periodicals previous to the current year have been removed from the periodical shelves, recorded on serial card, and missing numbers sent for.

A new circulation scheme is being installed which consists of a book card on which will be kept a permanent record of the persons to whom the book has been issued, and a borrower's card on which are recorded all books issued.

DIVISION OF STATISTICS.

The character of the statistical reports has very materially improved during the past twelve months. These reports are rendered more regularly and promptly and the data furnished have been more reliable than heretofore. The use of circular letters to all municipal presidents outlining the use of the blank forms has probably been more instrumental than anything else

in improving the quality of these reports. The "apparent errors" sheets have also helped a great deal.

The labor of auditing and tabulating the figures which appear on the crop reports and on the animal lists has, for the past year, been the same as stated in last year's annual report from this division. It has been the effort of this division to be sure that data were reasonable and in accord with the facts before releasing them for publication. This has required careful checking and frequent return of reports to municipal presidents for correction. The work of the division seems to be appreciated more highly than in previous years and officials of other Bureaus frequently call for our statements in minute detail. As in previous years Bureau of Agriculture statistics are in great demand by foreign consuls, merchants representing foreign firms, and by students in schools and colleges where agricultural research is being pursued.

DIVISION OF MACHINERY AND CONSTRUCTION.

The operations of this division include the Pandacan forage factory, the Pandacan repair shop, steam and motor plowing, and the supervision of all work pertaining to the purchase, construction or installation of machinery and buildings of the Bureau.

PANDACAN FORAGE FACTORY.

The work of this factory is to manufacture crushed and mixed feeds, consisting principally of Philippine maize, together with a smaller amount of imported bran and beans. The main object for which the factory was established was to develop the use of local forage products.

During the past year 641 tons of maize were purchased at an average price of ₱40 per ton on the cob. Ninety-two tons of bran at an average price of ₱70, and 90 tons of beans at an average price of ₱100 were also purchased. The maize was bought at a time of the year when it was wet and heavy and a part of it molded, causing considerable loss. Later on, as it dried, it became infested with weevils which was another source of loss. Fumigating bins were constructed but the transferring of the grain to and from same was attended with considerable loss. At the end of the fiscal year there remained in stock about one hundred tons of maize.

The bran has been kept in fair condition having been only slightly attacked by the weevils. That remaining at the end of

the fiscal year, about 40 tons, is still in good condition. The beans are in good condition and about 65 tons remain at the end of the fiscal year.

PANDACAN REPAIR SHOP.

The work of the repair shop includes the repair of all bureau property, and the construction of such articles as can be economically made at this shop.

A number of skilled and semiskilled workmen, and also laborers, are employed to carry on the work under the supervision of the superintendent. One hundred and forty-seven motorcycles and 137 bicycles came into the shop during the year for repairs. Besides this, parts of motorcycles, bicycles, etc., were shipped to the provinces and there placed on broken machines. One hundred and one work orders were received and accomplished consisting of various kinds of office furniture and other miscellaneous articles made and repaired.

STEAM AND MOTOR PLOWING.

It was proposed to conduct further experiments with steam and motor plows to determine, if possible, a more economical means of preparing the land for rice and sugar. In order to carry out these experiments, a plow of heavy construction was designed and constructed according to plans and specifications prepared by the chief of the division of machinery and construction. This plow has not yet been used, as it was received subsequent to the resignation of the chief of this division, and no employee has been available to supervise this work.

H. T. EDWARDS,
Acting Director of Agriculture.

The SECRETARY OF PUBLIC INSTRUCTION,
Manila, P. I.

GENERAL AND STATISTICAL TABLES.

No. 1.—*List of directing and superintending officers.*

[July 1, 1913.]

FREDERIC W. TAYLOR, *Director of Agriculture.*
H. T. EDWARDS, *Assistant to the Director.*

DIVISIONS.

Divisions.	Chief of division.
Clerical	W. E. Cobey.
Finances and property	T. R. Flack.
Animal husbandry	C. W. Edwards.
Veterinary	A. R. Ward.
Agronomy	C. M. Conner.
Horticulture	O. W. Barrett.
Fiber	M. M. Saleeby.
Demonstration and extension	H. T. Edwards.
Publications	S. Stickney.
Statistics	B. P. Lukens.
Machinery and construction	(Vacant).

EXPERIMENT STATIONS AND STOCK FARMS.

Station or farm.	Superintendent.
Alabang stock farm	H. F. Hungerford.
Trinidad stock farm	A. L. Bradley (acting).
La Carlota experiment station	H. J. Gallagher.
Lamao experiment station	F. C. Kingman.
Singalong experiment station	H. R. Reed (acting).

DEMONSTRATION AND BREEDING STATIONS.

Station.	Province.	Superintendent.
Iloilo	Iloilo	Sam. H. Sherard.
Virac	Albay	E. H. Koert.
Batangas	Batangas	H. T. Nielsen.
Ilagan	Isabela	O. S. Soriano, in charge.
Trinidad Garden	Mountain	Austin M. Burton.
Santa Cruz	Laguna	Peter Braun.

No. 2.—*Inspections at the port of Manila for the fiscal year ended June 30, 1913.*

Port of embarcation.	Number on arrival.		Shipped to provinces.		Deaths.	
	Cattle.	Carabaos.	Cattle.	Carabaos.	Cattle.	Carabaos.
Philippine	4,833	1,171	3,337	1,136	40	43
Pnom Penh (Indo-China)	898	286	1,388	433	50	27
Formosa			132	5	15	
Australian	68		131		18	
Total	5,799	1,457	4,988	1,574	123	69

No. 3.—*Inspections at port and city of Manila during fiscal year ended June 30, 1913.*

Kind of animals.	Inspected on arrival.				Arrived from—	
	Total.	Without fees.	Rate per head.	Fees collected.	Foreign ports.	Philippine ports.
Cattle	5,799	17	₱0.20	₱1,156.40	966	4,833
Carabaos	1,457	1	.40	582.40	286	1,171
Horses	1,789	465	1.00	1,324.00	416	1,373
Hogs	63,812	35	.10	6,377.70	21	63,791
Sheep	94		.20	18.80		94
Goats	920	4	.20	183.20	3	917
Other animals	111		.40	44.40	30	81
Total	73,982	522		9,686.90	1,722	72,260

REMARKS.—Seventeen cattle, 1 carabao, 68 horses, 35 hogs, and 4 goats admitted free on arrival (Civil Government); 397 mules admitted free on arrival (United States Army); 1 carabao died from tetanus; 13 horses killed for glanders; 12 horses died from glanders; 8 horses killed for surra; 18 hogs found dead in owners' corral; 2 hogs found dead in railroad station.

No. 4.—*Live-stock report of inspections port and city of Manila during fiscal year ended June 30, 1913.*

Kind of animals.	Number on arrival.	Shipped.	Slaughtered.	Dead.
Cattle	5,799	4,988	1,631	120
Carabaos	1,457	1,574		83
Horses	1,789	790		205
Hogs	63,812	181	66,616	26
Sheep	94	30	13	0
Goats	920	79	1,455	1
Other animals	111	113	3	1
Total	73,982	7,755	69,718	436

No. 5.—*Post-mortem inspections in Manila abattoir during fiscal year ended June 30, 1913.*

Kind of animals.	Passed for food.	Condemned.	Total.
Cattle	1,612	7	1,619
Calves	12		12
Swine	65,706	910	66,616
Goats	1,455		1,455
Sheep	13		13
Deer	3		3
Total	68,801	917	69,718

No. 6.—*Condemnations in Manila abattoir during fiscal year ended June 30, 1913.*

Causes.	Cattle.		Swine.		Goats.	
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.
Suspicious rinderpest and dying condition	1					
Lesion suspicious of rinderpest		6				
Comatose condition	4					
Extreme emaciation, enteritis	2		3			
Tuberculosis		9	7	902		
Cysticercus			884	7		
Hog cholera			8	17		
Icterus			6	5		
Septicemia			1			
Pyemia			1			
Found dead	7		12			
Parasitic infestation and cirrhosis		332		1,433		890
Hypostatic congestion		158		11,351		69
Broncho-pneumonia		17		3		4
Inflammation		12		67		
Hypertrophied		2		18		1
Abcesses and contaminations		3		28		
Cysts and sclerosis				182		
Hematoma, bruised, etc		118		29		2
Total	14	657	922	14,042		966

Causes.	Sheep.		Deer.	
	Carcasses.	Parts.	Carcasses.	Parts.
Suspicious rinderpest and dying condition				
Lesion suspicious of rinderpest				
Comatose condition				
Extreme emaciation, enteritis				
Tuberculosis				
Cysticercus				
Hog cholera				
Icterus				
Septicemia				
Pyemia				
Found dead				
Parasitic infestation and cirrhosis		12		2
Hypostatic congestion				
Broncho-pneumonia				
Inflammation				
Hypertrophied				
Abcesses and contaminations				
Cysts and sclerosis				
Hematoma, bruised, etc				
Total		12		2

No. 7.—*Total cases and deaths from various diseases during fiscal year ended June 30, 1913.*

Provinces.	Rinderpest.				Foot-and-mouth disease.				Hemorrhagic septicemia.			
	Cases.		Deaths.		Cases.		Deaths.		Cases.		Deaths.	
	Carabaos.	Cattle.	Carabaos.	Cattle.	Carabaos.	Cattle.	Carabaos.	Cattle.	Carabaos.	Cattle.	Carabaos.	Cattle.
Abra												
Agusan	4											
Ambos Camarines	11	1	16									
Antique	12	2	10									
Bataan												
Batangas												
Benguet												
Bohol	24	6	9	2								
Bulacan												
Cagayan	180		157									
Capiz	30		16		480	14		1				
Cavite	22		18									
Cebu												
Ilocos Norte	200	42	106	32								
Ilocos Sur	24	35	6	12								
Iloilo	43	3	30	2								
Isabela	5		1									
Laguna	15	4	3	4					42		42	
La Union	424	14	177	7								
Leyte	75	25	48	23								
Manila		22		11		576		9				
Misamis												
Mountain	71	3	33	1								
Nueva Ecija												
Nueva Vizcaya												
Occidental Negros												
Oriental Negros												
Pampanga	1,758	27	1,318	17								
Pangasinan	293	21	178	13					14		14	
Rizal	49	6	37	6							56	
Sorsogon												
Surigao												
Tarlac	27	41	20	25								
Tayabas												
Zambales	813	399	254	195								
Total	4,080	651	2,437	350	480	590		10	56		112	

Provinces.	Surra.									Glanders (horses).		
	Cases.			Deaths.			Killed.			Cases.	Deaths.	Killed.
	Carabaos.	Cattle.	Horses.	Carabaos.	Cattle.	Horses.	Carabaos.	Cattle.	Horses.			
Abra												
Agusan												
Ambos Camarines												
Antique												
Bataan												
Batangas												
Benguet												
Bohol												
Bulacan												
Cagayan												
Capiz												
Cavite												
Cebu												
Ilocos Norte			7			6			2			
Ilocos Sur												
Iloilo			14			5						
Isabela			18			12			12			
Laguna												
La Union												
Leyte			23			21			10			
Manila									8		12	13
Misamis												
Mountain			14						14			
Nueva Ecija												1
Nueva Vizcaya			69			18			48	25	12	7
Occidental Negros												
Oriental Negros			5			8			4			
Pampanga												
Pangasinan												
Rizal												
Sorsogon												
Surigao										1	1	
Tarlac			2			1			1	9	7	5
Tayabas												
Zambales												
Total			152			71			99	35	32	26

No. 7.—*Total cases and deaths from various diseases during fiscal year ended June 30, 1913*—Continued.

Provinces.	Lymphangitis (horses).		Other diseases.						Death from diseases unknown.		
	Cases.	Deaths.	Cases.			Deaths.			Carabaos.	Cattle.	Horses.
			Carabaos.	Cattle.	Horses.	Carabaos.	Cattle.	Horses.			
Abra											
Agusan											
Ambos Camarines			21	39		22	9		8	3	
Antique											
Bataan											
Batangas			43	116	27	44	124	34		3	
Benguet											
Bohol					11			3	76	8	10
Bulacan									2		
Cagayan											
Capiz											
Cavite									1	3	4
Cebu						18	34	6	355	65	110
Ilocos Norte											
Ilocos Sur											
Iloilo		1									
Isabela											
Laguna									4		
La Union			5	3		3	3		1		
Leyte			1	2	5	22	7		50	5	30
Manila						36	51	131	26	16	52
Misamis											
Mountain						14					
Nueva Ecija									2		10
Nueva Vizcaya											
Occidental Negros											
Oriental Negros									8	1	5
Pampanga									16		
Pangasinan											
Rizal						8			4		
Sorsogon											
Surigao			115	2		111	2		19		
Tarlac			19			23					
Tayabas									1		
Zambales			37	6	8	133	31	32	42	15	11
Total		1	241	168	51	434	261	206	615	119	232

No. 8.—*Live stock passing through Pandacan quarantine station during fiscal year ended June 30, 1913.*

	Cattle.	Carabaos.
On hand July 1, 1912	207	31
Received during year	876	287
Slaughtered in Pandacan		
Died in station	44	26
Released	1,039	292
On hand June 30, 1913		

No. 9.—*Post-mortem inspections of cattle in Sisiman abattoir and causes of condemnation during fiscal year ended June 30, 1913.*

Causes.	Inspections.	Passed.	Carcasses.	Parts.
Abscesses	9,697	9,646		43
Acute fever			1	
Advance pregnancy			1	
Bruises				117
Congestions				36
Enteritis				1
Fatty degeneration				10
Found dead			20	
Heat stroke			1	
Icterus				17
Inflammations				11
Parasitic nodules				5
Peritonitis			1	
Pleuropneumonia			12	1,092
Tuberculosis			15	2,334
Total	9,697	9,646	51	3,666

No. 10.—*Live-stock purchases for Government branches other than the Bureau of Agriculture.*

Disposition.	Horses.		Cattle.		Swine.		Mules.		Total.		Surcharge.
	Number.	Purchase price.	Number.	Purchase price.	Number.	Purchase price.	Number.	Purchase price.	Number.	Amount.	
Bureau of Constabulary	19	₱4,905.00							19	₱4,905.00	₱98.10
Bureau of Education	1	150.00			2	₱60.00			3	210.00	18.00
Bureau of Prisons	8	2,250.00							8	2,250.00	225.00
Province of Batangas							2	₱600.00	2	600.00	60.00
Province of Iloilo							2	924.00	2	924.00	92.40
Mountain Province	1	400.00							1	400.00	
Province of Ambos Camarines			2	₱250.00					2	250.00	25.00
City of Manila	3	600.00							3	600.00	60.00
Province of Agusan			8	920.00					8	920.00	92.00
University of the Philippines					3	90.00			3	90.00	9.00
Total	32	8,305.00	10	1,170.00	5	150.00	4	1,524.00	51	11,149.00	679.50

No. 11.—*Sale of Bureau animals.*

Credit.	Horses.		Mules.		Cattle.		Carabaos.		Swine.		Goats.		Total.	
	Number.	Price.	Number.	Price.	Number.	Price.	Number.	Price.	Number.	Price.	Number.	Price.	Number.	Price.
Alabang stock farm	14	₱1,800.00	2	₱500.00	10	₱670.00			27	₱895.00	13	₱85.00	66	₱3,950.00
La Carlota experiment station					3	280.00					1	10.00	4	290.00
Trinidad stock farm	1	150.00			5	300.00							6	450.00
Trinidad garden			2	1,000.00	6	660.00							8	1,660.00
Lamao, Bataan									2	55.00			2	55.00
Ilagan tobacco station									1	35.00			1	35.00
Tanculan, Bukidnon					1	60.00							1	60.00
Sisiman, Bataan					4	160.00							4	160.00
Total for division of animal husbandry	15	1,950.00	4	1,500.00	29	2,130.00			30	985.00	14	95.00	92	6,660.00

Pandacan quarantine station					8	₱555.00							8	₱555.00
San Lazaro immunizing station							2	₱96.00					2	96.00
Research laboratory					7	105.00							7	105.00
Total veterinary division					15	660.00	2	96.00					17	756.00
Grand total													109	7,416.00

No. 12.—*Summary of public breeding.*

Station.	Property number of sire.	Time at station.	Services.	Foals.	Total for station.	
					Services.	Foals.
Virac	D. of A	July 1, 1912	119	40		
	B-12	do	68	20		
	40	do	13	26		
	A-121	do		6		
	123	Feb. 6, 1913	111		311	92
Vigan	73	July 1, 1912	55		55	
Ilagan	864	do	36		36	
Larena	121	do	68	2		
	185	do	52		120	2
Dumaguete	122	Dec. 1, 1912	28		28	
Payo, Viga	166	Feb. 16, 1913	39	2		
	117	do	21	3		
	116	do	35	14		
	184	do	29	4	124	23
Batangas	A-107	Nov. 5, 1912	126			
	A-21	Nov. 2, 1912	113			
	B-79	do	116			
	A-106	Feb. 24, 1913	61			
	63	Nov. 30, 1912	17		433	
Iloilo	B-101	Oct. 12, 1912	2		2	
Bangued	B-1	July 1, 1912	101		101	
La Carlota	L-118	do	3	2	3	2
Alabang	A-107	July–Nov.	4			
	126	July 1, 1912	4			
	119	do	27		35	
Total (25)					1,248	119

This list does not include data on other public breeding animals such as bulls, boars, etc.

No. 13.—*Bureau animals born during the year.*

Station.	Horses.	Cattle.	Carabaos.	Swine.	Goats.	Guinea pigs.	Rabbits.	Total.
Alabang	20	32		43	66			161
La Carlota	16	47	8		11			82
Trinidad		36						36
Singalong	2							2
Laboratory						456	65	521
Bukidnon		3						3
Lamao				2				2
Veterinary mares	2							2
Total	40	118	8	45	77	456	65	809

No. 14.—*Deaths of Bureau animals during the year.*

Station.	Horses.	Mules.	Burros.	Cattle.	Sheep.	Carabaos.
Alabang stock farm	17			23	1	
Trinidad stock farm				10		
La Carlota experiment station	3			7	1	2
Lamao experiment station			1			
Research laboratory	9	1		135	2	4
Singalong experiment station	1	2		2		
Ilagan tobacco station						1
San Lazaro immunizing station		2		1		1
Field	20			1		
Total	50	5	1	179	4	8

Station.	Goats.	Swine.	Monkeys.	Rabbits.	Guinea pigs.	Total.
Alabang stock farm	11	28				80
Trinidad stock farm						10
La Carlota experiment station	8	4				25
Lamao experiment station		7				8
Research laboratory	5	1	96	17	364	634
Singalong experiment station		3				8
Ilagan tobacco station		6				7
San Lazaro immunizing station						4
Field	1					22
Total	25	49	96	17	364	798

NOTE.—Nearly the entire number of deaths occurring at the research laboratory was experimental animals.

No. 15.—*Number and location of Bureau animals at end of year.*

Station.	Horses.	Cattle.	Goats.	Mules.	Carabaos.	Swine.	Sheep.
Alabang stock farm	75	178	99			42	13
La Carlota experiment station	46	159	16	1	26	3	
Trinidad stock farm	3	116					
Research laboratory	28	56	2				5
Iloilo demonstration station	1	7	2			2	
Singalong experiment station	10			6		9	
Ilagan tobacco station	3				3		
Pandacan quarantine station		8					
Provincial breeding stations	23	3	4			5	
Bukidnon		16				1	
Lamao experiment station		4		1			
Bodega	53			11			
Total	242	547	123	19	29	62	18

Station.	Burros.	Deer.	Rabbits.	Monkeys.	Guinea pigs.	Total.
Alabang stock farm						407
La Carlota experiment station						251
Trinidad stock farm						119
Research laboratory		3	22	19	357	492
Iloilo demonstration station						12
Singalong experiment station						25
Ilagan tobacco station						6
Pandacan quarantine station						8
Provincial breeding stations						35
Bukidnon						17
Lamao experiment station	7					12
Bodega						64
Total	7	3	22	19	357	1,448

No. 16.—*Distribution of Philippine Agricultural Review, fiscal year 1912–13.*

	English.	Spanish.
Paid subscriptions	172	193
Exchanges, foreign and local periodicals	205	78
Bureau of Education	322	
Government officials and free subscriptions	1,224	1,167
Total monthly distribution	1,923	1,438
Grand total monthly distribution	3,361	

No. 17.—*Complete mailing list of the Philippine Agricultural Review, fiscal year 1912–13.*

Manila:	
English edition	597
Spanish edition	182
United States:	
English edition	424
Spanish edition	4
Foreign:	
English edition	391
Spanish edition	70
Provincial:	
English edition	511
Spanish edition	1,182
Total for Manila, United States, and foreign	1,668
Total for provinces	1,693
Grand total	3,361
Total for English edition only	1,923
Total for Spanish edition only	1,438

No. 18.—*Cost of publishing and delivering the Philippine Agricultural Review, fiscal year 1912–13.*

Date.	Copies.		Printing.		Wrappers.	Postage.
	English.	Spanish.	English.	Spanish.		
July	2,500	3,000	₱790.95	₱794.85		₱37.96
August	2,500	3,000	668.85	679.30		13.34
September	2,000	2,500	554.90	606.75		13.00
October	2,000	2,500	458.78	534.30		12.04
November	2,000	2,000	724.66	613.20		23.24
December	2,200	2,200	770.07	693.55	₱280.65	17.38
January	2,000	2,000	640.90	533.10		26.22
February	2,000	2,000	766.52	638.60		19.14
March	2,000	2,000	733.23	570.90		18.47
April	2,000	2,000	584.80	634.05		1.30
May	2,000	2,000	711.31	589.70		29.37
June	2,200	2,200	719.87	607.40		33.35

	Copies.	Cost.
Index to Volume V (English)	1,000	₱246.12
Title page for Volume V (English)	200	6.55

No. 19.—*Paid subscriptions to the Philippine Agricultural Review, fiscal year 1912–13.*

	English.	Spanish.
United States	16	1
Guam	1	
Hawaii	1	
PHILIPPINE ISLANDS.		
Manila	48	37
Agusan	1	1
Albay		3
Antique		2
Bataan		1
Batangas	1	7
Bohol		1
Bulacan		5
Cagayan	1	2
Camarines	1	2
Capiz	1	4
Cavite	5	1
Cebu	2	4
Ilocos Norte		2
Iloilo	3	6
Isabela	1	
Laguna	4	4
La Union	7	1
Leyte	5	9
Masbate, Sorsogon	2	4
Mindoro	2	5
Misamis	2	6
Moro	23	5
Mountain		1
Nueva Ecija	3	1
Nueva Vizcaya		1
Occidental Negros	2	13
PHILIPPINE ISLANDS—cont'd.		
Oriental Negros	1	2
Palawan	1	5
Pampanga	4	16
Pangasinan	2	4
Rizal	1	7
Samar	4	4
Sorsogon		6
Surigao	2	2
Tarlac		4
Tayabas	1	11
Zambales	2	1
FOREIGN.		
Australia	2	
Belgium	1	
Ceylon	1	
Cuba	2	
England	2	
Federated Malay States	3	
Germany	1	
India	3	
Indo-China	1	
Italy		1
Japan	1	
New Caledonia	1	
New Guinea	1	
Switzerland	2	
Timor	1	
Venezuela		1

No. 20.—*Planotype work, fiscal year 1912–13.*

	Work orders.
Manuscript	111
Tabular	87
Cards, etc	75
Total work orders	273
Total copies printed for 273 work orders	253,715
Work orders by divisions:	
Veterinary	118
Finances and property	56
Clerical	42
Demonstration and extension	14
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Publications	11
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Total	273

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